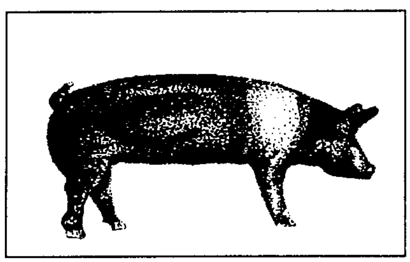
COMPREHENSIVE NUTRIENT MANAGEMENT PLAN

Kenneth Rust

Rec'd
11-3-08
DOW

In

CARLISLE County, Kentucky



Assisted by
United States Department of Agriculture
Natural Resources Conservation Service

Nutrient Management Plan, Pages 1-9

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Preface

This Nutrient Management Plan has been developed to accompany a request to construct and operate a new Swine Feeding Facility owned and operated by Kenneth Rust in Carlisle County Kentucky. This nutrient management plan has been developed based on information provided by Tosh Farms Company Representatives, with technical assistance provided by the University of Kentucky Cooperative Extension Service, and the Natural Resources Conservation Service. This plan has been developed in accordance with the Kentucky NRCS Nutrient Management Field Office Technical guide standard 590 that is currently in effect as of October 3rd, 2008.

System Description

This swine feeding facility will consist of Two (2) Tosh Farms, nursery to finish hog barns. All feeding and manure collection will be under roof, on concrete slated floors directly over a deep concrete pit. Hogs will be watered using new technology drinking system to minimize the addition of water into the pit. Soil samples have been analyzed by University of Kentucky. using the Mehlich-3 method and a NRCS Phosphorus index rating has been completed to verify the planning and implementation of a Nitrogen Based Nutrient Management Plan. Liquid manure will be injected each spring from April through Mid May at a rate to meet the nutrient needs of Corn based on University of Kentucky Nutrient recommendations, AGR-1. **See Appendix B – Page 1, " Tosh Farms two (2) Barn System Flow Chart."**

Manure Collection and Storage

Manure generated by this operation will be stored in a deep concrete pit, which is located beneath a slated floor. Based on company design and floor plans, the pit will have an inside storage dimension of 195.5 feet long by 99.5 feet wide with a effective storage depth of 7.33 feet. After making reductions for concrete supports and pillars the pit will have a maximum storage capacity of approximately 141,911.39 cubic feet. **See Appendix A, Tosh Farms Standard Hog Barn Pit Dimension and Foundation Plans.**

Estimated Amount of Liquid Manure Generated

Based on information obtained from Tosh Farms Company representatives, each barn will be populated with approximately 2,480 head. Animals will arrive at approximately 15.0 lbs and be harvested at approximately 260 lbs. The average weight (130.0 lbs) was derived by swine growth curves in consultation with U.K. Extension Ag Engineer and Swine specialist. The annual confinement period was reduced from 365 days to 345 days to account for time periods necessary to conduct cleanout, disinfection and maintenance. NRCS has estimated the total amount (two barns) of Liquid waste Generated per confinement period to be approximately 278,640.4 Cubic Feet. Based on 1 cubic foot containing 7.5 gallons, this equates to approximately 2,089,803.0 gallons of liquid waste. **See Appendix B, page 2 – Estimating Animal Waste Generated per Confinement period.**

- *Manure per A.U. factor of 1.15 cu.ft./A.U. & Gallons per head day of 0.1 gallons differs from Table I of KYFOTG 590. These revised factors where determined to be more representative during NRCS, U.K. and Tosh Farms meeting held 12/20/2005.*

Nutrient Analysis

A manure sample was pulled in November of 2005 from an existing, Tosh Farm Hog Barn currently in operation on a nearby farm owned by Charlie Cannon. Management will be the same for this new application, so this nutrient analysis has been used rather than NRCS book value listed in KY FOTG 590 to more accurately estimate the total amount of nutrients generated per confinement period. **See appendix B, sheet 3 --U.K. Manure Sample Report dated 11-17-2005.**

Estimated Amount of Total Available Nutrients Generated

Using the availability coefficient found in KY NRCS FOTG standard 590, appendix A, Table 5, NRCS has estimated that 51,409.15 lbs of total plant available nitrogen will be produced along with 53,498.95 lbs of total available phosphorus and 58,514.48 lbs of potassium. **See Appendix B -- Page 4 "Estimating Nutrients Generated Per Confinement Period."**

Determining Nutrient Based Plan

Option 1 -- Soil Test Phosphorus Threshold (PT) Levels

Soil samples have been collected from all fields and analyzed by University of Kentucky. using the approved Mehlich-3 method. Based on soil test reports it was determined that none of the fields have a residual Soil Test Phosphorus (STP) level that is equal to or greater than 400 lbs per acre. Based on KY NRCS FOTG Standard 590, when the STP levels are less than 400 lbs per acre as the operator I have the option of implementing a nutrient management plan based on nitrogen utilization. **See Appendix B, page 5 – Determining Nutrient Based Plan Flow Chart.**

Option 2 -- Phosphorus Index (PI) rating

In addition to soil sampling, the NRCS office in Carlisle County has also completed a Phosphorus Index rating for all fields. It has been determined by NRCS that based on following the recommendations of the Conservation plan, all of the fields will have a "medium" potential for phosphorus movement. Based on KY NRCS FOTG Standard 590, a phosphorus index rating of low to medium also permits me as the operator to implement a nutrient management plan based on nitrogen. **See Appendix B, page 5 – Determining Nutrient Based Plan Flow Chart.**

Crop and Cropland Needs to Apply Nitrogen Based Plan

Swine waste will be applied to meet the nitrogen needs of corn based on AGR-1, University of Kentucky Cooperative Extension Service, Lime and Nutrient Recommendations. For corn planted using conservation tillage on Moderately well to somewhat poorly drained soils, AGR-1 recommends a minimum nitrogen rate of 165 lbs/ac. At this rate it will require approximately 311.6 acres of corn to fully utilize the total amount of plant available nitrogen (PAN) generated per confinement period. Corn will be grown in rotation with full season soybeans and or wheat and double crop soybeans. This will require, at minimum of 623.2 acres to complete and maintain this crop rotation. **See Appendix B, Page 6cwb and Page 6cb – Estimating Cropland Needed to Utilize Nutrients.**

Utilization of Phosphorus Carryover by Crop Rotation

Based on the example Swine waste analysis, it will require approximately 6,706.7 gallons per acre to obtain the planned 165 lbs per acre of plant available Nitrogen (PAN). This application rate will also result in the application of approximately 171.7 lbs/ac of Phosphate (P205) and 187.8 lbs/ac of Potassium (K2O).

The uptake or utilization of total phosphorus and potassium will be based on the estimated plant needs of the Corn + Wheat + Soybeans, (page 6cwb) and on bottomland, a Corn + Full Season Soybean rotation (page 6cb). The calculation for uptake of P & K is based on KY NRCS FOTG Standard 590, appendix A, table 6, "crop nutrient removal values". The yields used in the calculation of this value is based on the National Agriculture Static's Service (N.A.S.S.) 5 year average Corn, Wheat and Soybean yields for Carlisle & Hickman County Kentucky.

NRCS 590 estimates that after a Corn, wheat and soybean rotation, approximately 63.7 lbs/acre of phosphorus and 83.8 lbs/ac of potassium carryover is projected. Furthermore, on the somewhat poorly drained bottomland where wheat will not be grown in the rotation, a projected carry over of 80.7 lbs/ac of phosphorus and 83.8 lbs/ac is estimated as carryover. At this time potassium carry over is not considered a water or soil quality concern. **See Appendix B, page 6cb and page 6cwb – Estimating Cropland Needed to Utilize Nutrients.**

Additional application of Commercial fertilizer

No additional applications of phosphorus and potassium will be applied to crop fields planned for application of animal waste. However, additional applications of Nitrogen will be applied to completely fill or meet the maximum nitrogen recommendations for wheat. Total nitrogen applied will be based on University of Kentucky Cooperative Extension Service publication AGR-1. At this time plans are to applying an additional spring application of 95 lbs/ac Nitrogen to wheat. **See enclosed Appendix D for AGR-1 and Appendix B, pages 7 & 8 for summary record of planned commercial fertilizer application.**

Land Application Location, Acreage, Methods, Timing, Form, and Rates

Manure will be applied using a liquid vacuum implement typically used to inject swine manure. Manure will be injected in the spring when ground conditions permit and not greater than 30 days prior to the planting of corn. **See Appendix B, page 7 & 8 – Planned Application Summary record to obtain farm ID information, field numbers, cropland acres, planned crop, application timing, form of waste, application method, planned nitrogen application rates, manure application rates in gallons per acre, Soil Test Phosphorus levels and NRCS Phosphorus Index (PI) ratings.**

Major Land Application Operation and Maintenance Requirements

- Liquid manure shall not be applied on saturated, frozen and/or snow-covered soil.
- Liquid manure shall not be applied more than 30 days prior to planting of corn.
- Liquid manure shall not be applied in any defined drainage way that carries concentrated water flow.
- Liquid manure shall not be applied 48 hours prior to a forecast of rain (50% chance) or within 48 hours of receiving at least a ½ inch rain.
- Equipment shall be calibrated to ensure liquid manure is applied at recommended rates.
- Liquid manure shall be injected or immediately incorporated into the soil.
- Soil erosion shall be controlled according to NRCS developed Conservation Plan.

Minimum Land Application Setbacks

Liquid manure shall not be applied within the following minimum land application setbacks;

- 1000 feet of an incorporated city limits,
- 500 feet of any dwelling other than applicant
- 150 feet of a well not owned by applicant,
- 75 feet from a river, lake or solid blue line stream on a USGS 7.5 minute quad map

Best Management Practices – Conservation Practices

The following conservation practices or Best Management Practices (BMP's) will be applied to minimize the movement of nutrients, pathogens, organic materials, and soil to surface waters.

- Conservation Crop Rotation: (328) (Corn, wheat, Beans)
- Residue and Tillage Management, No-till: (329)
- Residue and Tillage Management, Mulch Till: (345)
- Grassed Waterways: (412) (As needed for gully control)
- Grade Control Structures: (410) (As needed to prevent/control head cutting)
- Filter Strips: (393) (As needed when immediately adjacent to blue line streams)
- Nutrient Management: (590)

Refer to enclosed NRCS Conservation Plan attached in Appendix C of this Nutrient Management Plan.

Soil Testing Procedures

Soil nutrient levels shall be monitored by soil testing to determine the buildup of phosphorus and potassium in the soil. Soil test analysis must include at minimum pH, phosphorus, and potassium. Agriculture lime shall be applied to maintain or adjust the pH to a range between 6.5 to 7.2. Routine soil testing by field shall occur according to University of Kentucky guidelines when nutrients in any form are land applied during the crop year.

Soil samples are to be collected in accordance with The University of Kentucky extension service guidance.
Soil testing is to be performed by laboratories that meet all of the following:

- Certification In The North American Proficiency Testing Program (Soil Science Society of America)
- Other laboratories whose test results are accepted by The University of Kentucky
- Soil Test Phosphorus (STP) is determined by the Mehlich III method

Soil profile sampling for nitrogen, Pre-Side dress Nitrogen Test (PSNT), Pre-Plant Soil Nitrate (PPSN) or soil surface sampling for phosphorus or acidity may be necessary in situations where there are special production or environmental concerns.

See in attached Appendix D, University of Kentucky's cooperative Extension service publication, AGR-16, titled, "Taking Soil Test Samples".

Manure Testing Procedures

Testing of the manure shall include an analysis for Total Nitrogen, Phosphorus and Potassium. Since the swine waste will be in liquid form and applied using a flow meter, the results should be obtained in pounds of nutrients per 1000 gallons. Annual testing of manure is not required unless management changes occur that could alter the analysis data collected in a prior year. **Procedures for collecting manure samples are provided in Appendix D of this plan.**

Manure Sold and No Longer Under Control

Due to record high nutrient prices, manure generated by this system may be sold for it's soil amendment properties. If this situation arises, as the operator, I understand that I am responsible for documenting quantities of manure transported off-site; including the name of the recipient, date and amount transported. **This documentation will be maintained in the Appendix E – "Record Keeping" Section of this nutrient management plan.**

Manure Transported Off-Site (Roads & Highways)

Manure will need to be transported off-site by using a Honey Wagon or Tanker truck. In case of an accidental spill, every effort shall be made to contain the manure on site and immediately report the incident to the Kentucky Department of Transportation, and the Kentucky Division of Water. All truck operators and vehicles will meet applicable KYDOT requirements to use State Highway and/or local county roads.

Feed Management

All swine feed rations are developed by Tosh Farms and delivered by the vertical integrator on a schedule that matches animal growth and development. Information provided by company representatives indicates that a feed additive "Phytase" is added to reduce the phosphate dietary requirements of the hogs and reduce the phosphate in the manure. Manure analysis will be used to monitor the actual phosphors content of the manure.

Dead Animal Management

Dead animals will be disposed of according to state or local laws and in a way that does not adversely affect ground or surface water or create public health concerns. Though animal mortality is a certainty, no deduction has been made in estimating the volume generated by the system. Dead animals will be "rendered" by Griffin Industries of Union City Tennessee.

Record Keeping

Tract, Crop unit and/or Field-by-field records shall be kept by the producer for a minimum of 5 years for fields where the producer has control to apply manures. Recordkeeping will include information pertaining to specific field manure applications. ***This information is to be maintained in Appendix E— "Record Keeping" section of this Nutrient Management Plan.***

Additional records for the operation shall include:

1. Soil test results - Lab using Melich III method to document the soil phosphorus level (STP).
2. Manure Analysis Report – Lab result of amount of N, P, K expressed in lbs/1000 gallons
3. Location manure was applied. (e.g. Farm name or tract no. field name/no.)
4. Date and method manure was applied.
5. Amount and form of manure applied
6. Crop type and acres planted
7. NRCS Phosphorus Index rating for tract/field(s).
8. Necessary documentation to account for sale of manure and no longer under control.
9. Documentation of any revisions, adjustments etc…

PLAN AGREEEMENT

Name of Operator: Kenneth Rust

The Kentucky Department For Environmental Protection Division of Water (DOW) acting under the authority of the Clean Water Act of 1972 requires that animal byproducts (manure, feedlot or holding area runoff, milk house supernatant, silo drainage, etc.) be managed so as not to enter the waters of the State. This Nutrient Management Plan provides the basic information on how the manure produced from your operation, and/or applied on your fields, will be utilized. Is this plan considered to be part of a Comprehensive Nutrient Management Plan (circle Yes or No). If **YES**, other components could apply that may not be referenced in this document. For further information reference Appendix C.

Operator Agreement

I (we) understand and will follow and implement this plan for the farm named above. I (we) know that any expansion or management change to the existing design capacity of the system will require a revised plan and possibly a new or revised permit. The approved plan should be filed on-site at the farm. When implementation of this plan is a required component of a regulatory permit or is mandated by other regulations, I will assume all responsibility for compliance. Manure that is sold or given away must be documented by the operator. The recipient is responsible for handling and utilizing the animal waste in accordance with state laws and regulations.

Signatures:

Operator Information (Persons Responsible For Plan Implementation):

Print Name: Kenneth Rust

Signature: X Kenneth D Rust Date: X 10-3-08

Print Name of Manager (if different from owner):____________________

Signature:____________________ Date:__________

Nutrient Management Plan Developer Information:

Print Name: Todd C. Templeton, NRCS Resource Conservationist

59 Construction Road, Mayfield KY 42066 Phone: (270) 247-9529, ext- 3

Signature: Todd C Templeton Date: 10-31-08

Certified Nutrient Management Planner: 21602016 TCT

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN (CNMP)

FOR

Kenneth Rust

September 2008

APPENDIX A

TOSH FARMS STANDARD HOG BARN DESIGN

TYPICAL TOSH HOG BARN PIT

Volume (cubic feet) = Length X Width X Depth

- **Length (inside) = 195.5 feet**
- **Width (inside) = 99.5 feet**
- **Effective Depth = 7.33 feet**

<u>195.5' X 99.5' X 7.33' = 142,584.99 cubit feet</u>

Reduce Storage area occupied by;

Support Columns 117 ea. X (IIr2 x7.33') = 673.6 cubic feet

<u>Total Available Storage= 141,911.39 cubic feet</u>

141,911.39 cubic feet x 7.5 gallons per cu.ft. = <u>1,064,335.4 gallons</u>

TOSH FARMS
STANDARD HOG BARN

GENERAL NOTES

1. THESE PLANS ARE EXCLUSIVELY FOR THE USE OF TOSH FARMS. THE ENGINEER SHALL NOT BE RESPONSIBLE FOR ANY USE OF THESE PLANS BY ANY OTHER PERSON OR ENTITY.

2. IT IS RECOMMENDED THAT A PERIMETER TRENCH DRAIN BE INSTALLED, AND MADE TO DRAIN TO A FREE OUTLET WHENEVER POSSIBLE TO RELIEVE LATERAL PRESSURES AGAINST THE PIT WALLS.

3. WHENEVER EXPANSIVE SOILS ARE PRESENT, THIS DESIGN SHOULD NOT BE CONSIDERED VALID UNLESS AT LEAST 2 FEET OF EXCESS SOIL IS EXCAVATED BELOW THE SLAB AND REPLACED WITH SUITABLE COARSE GRAINED MATERIAL.

4. UPLIFT OF THE STRUCTURE MAY OCCUR IF THE WATER TABLE IS WITHIN 6 FEET OF THE NATURAL GROUND SURFACE (2' ABOVE PIT FLOOR). IF HIGH WATER TABLE IS ENCOUNTERED OR SUSPECTED, ANOTHER SITE SHOULD BE SELECTED.

5. THESE PLANS DO NOT CERTIFY TO THE DESIGN OF THE PRECAST BEAMS, SLATS, OR BUILDING SUPERSTRUCTURE.

SHEET:	NUMBER:
DETAILS	S - 2

L. I. SMITH & ASSOCIATES, INC.
SURVEYORS · ENGINEERS

302 Nor [illegible] il Street
Paris, Tennessee 38242
731-644-1014 800-247-6847 FAX 731-644-0109

1100 Lebanon Pike, Suite 105
Nashville, Tennessee 37210
615-351-7143 FAX 615-256-0290

STRUCTU   ES

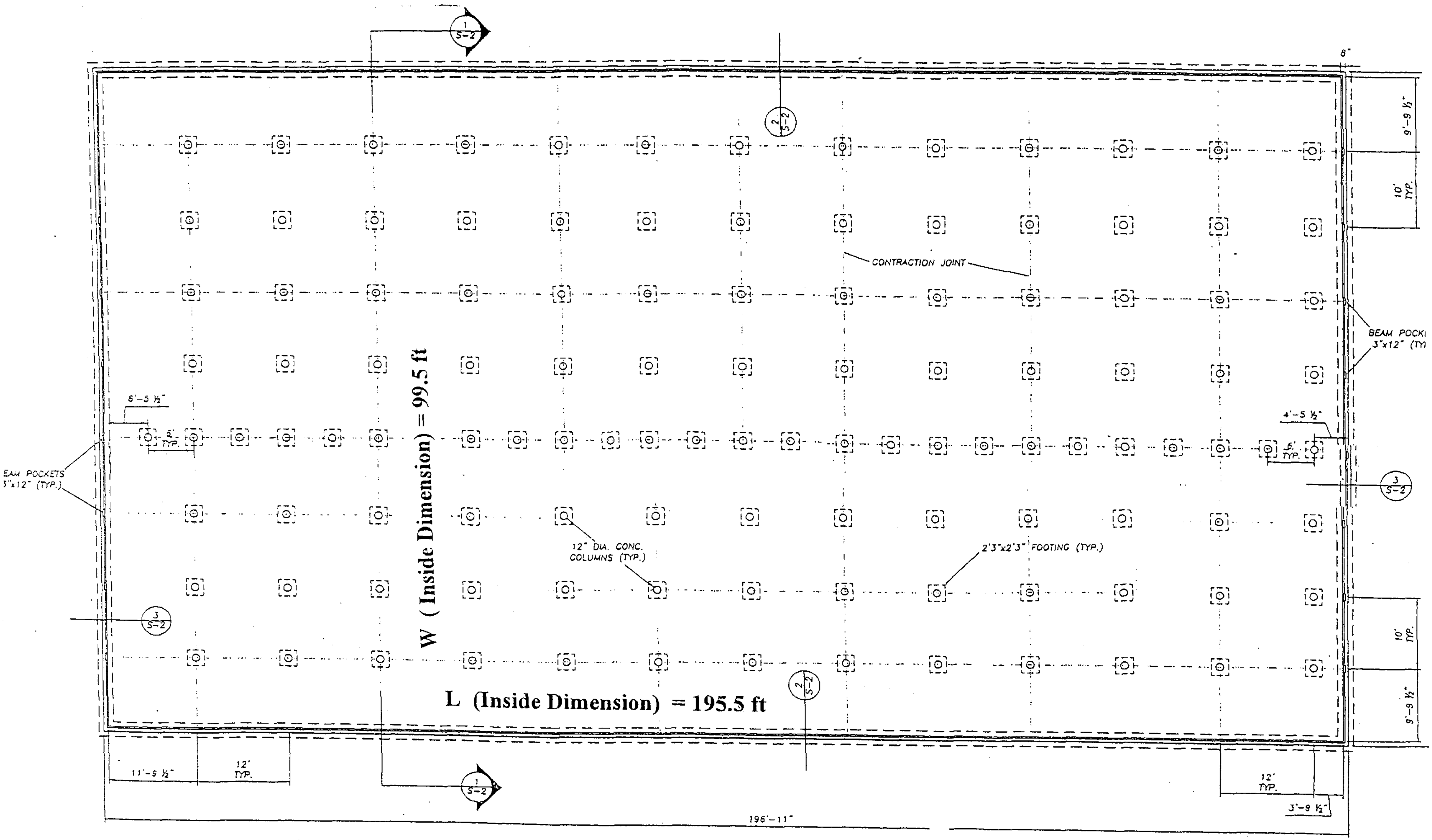
1. STRUCTU   LOADS
   A. ROOF DEAD LOAD
      a. MECHANICAL EQUIPMENT   1 PSF
      b. METAL ROOF   4 PSF
      c. WOODEN TRUSSES   1 PSF
   B. ROOF LIVE LOADS   20 PSF
   C. DESIGN WIND SPEED   90 MPH
   D. SEISMIC DATA
      a. SEISMIC DATA IS SITE SPECIFIC. THIS STRUCTURE IS NOT DESIGNED TO WITHSTAND LARGE SEISMIC LOADS.
   E. SNOW LOAD   15 PSF
   F. FLOOR LIVE LOAD   27 PSF
   G. FOUNDATIONS.
      a. DESIGN BEARING CAPACITY   2,000 PSF
   H. ALL MATERIALS AND CONSTRUCTION SHALL BE GOVERNED BY THE CODES LISTED IN THE APPROPRIATE SECTIONS.

2. EARTHWORK
   A. SITE PREPARATION.
      a. ALL AREAS BENEATH THE PROPOSED BUILDING AND FOUNDATION SHALL BE CLEAR AND GRUBBED.
      b. THE ENTIRE BUILDING PAD SHOULD BE PROOF-ROLLED WITH A LOADED PNEUMATIC WHEELED TRUCK. ANY AREAS THAT EXHIBIT SIGNIFICANT RUTTING OR PUMPING SHOULD BE EXCAVATED AND BACKFILLED WITH COMPETENT STRUCTURAL FILL.
      c. THE TOP 6" OF SUBGRADE SHOULD BE COMPACTED TO A MINIMUM OF 95% OF MAXIMUM DENSITY AS DETERMINED BY ASTM D 698 (STANDARD PROCTOR).
      d. IN ALL AREAS WHERE CONCRETE IS TO BE PLACED DIRECTLY AGAINST EARTH, THE SUBGRADE SHALL BE SUFFICIENTLY DAMP WITH NO FREE STANDING WATER TO ENSURE MOISTURE WILL NOT BE LOST DURING CONCRETE CURING PERIOD.
      e. GRADE SITE TO PROVIDE POSITIVE DRAINAGE AWAY FROM BUILDING IN ALL CASES.
   B. STRUCTURAL FILL.
      a. ANY REQUIRED FILL MATERIAL SHOULD BE PLACED IN LIFTS NOT EXCEEDING 9" IN DEPTH, ROLLED, AND COMPACTED TO A MINIMUM OF 95% MAXIMUM DENSITY AS DETERMINED BY ASTM D 698 (STANDARD PROCTOR).

3. CAST-IN-PLACE CONCRETE.
   A. DESIGN CODE: ACI 318 "BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE".
   B. CONCRETE CONSTRUCTION SPECIFICATIONS: NRCS CONSERVATION PRACTICE STANDARD NO. 313 "WASTE STORAGE FACILITY".
   C. CONCRETE REQUIREMENTS.
      a. MINIMUM COMPRESSIVE STRENGTH FOR ALL CONCRETE UNLESS NOTED OTHERWISE SHALL BE 4,000 PSI AT 28 DAYS.
      b. DESIGN SLUMP SHALL BE THAN 2" NOT TO EXCEED 4". IMMEDIATELY PRIOR TO PUMPING, A SUPERPLASTICIZER ADMIXTURE MAY BE ADDED, BUT MAY NOT INCREASE SLUMP BEYOND 7".
      c. THE AIR CONTENT SHALL BE 4% - 7% ACCORDING TO ASTM C 260.
   D. MATERIALS.
      a. CEMENT. TYPE I OR II PORTLAND CEMENT, ASTM C 150.
      b. WATER. CONFORM TO REQUIREMENTS OF ASTM C 94.
      c. AGGREGATES. NORMAL WEIGHT AGGREGATES CONFORMING TO ASTM C 33. FOR FLOOR SLABS, THE MAXIMUM NOMINAL AGGREGATE SIZE SHALL BE LESS THAN 1 INCH.
      d. FIBERS. MONOFILAMENT POLYPROPYLENE FIBER FILAMENTS OR OTHER APPROVED FIBERS. THE MINIMUM RATIO OF FIBERS SHALL BE 1.5 POUNDS PER CUBIC YARD OF CONCRETE.
      e. ADMIXTURES. ALL ADMIXTURES SHALL BE PROPORTIONED AND USED ACCORDING TO THE MANUFACTURER'S INSTRUCTIONS. CALCIUM CHLORIDE, IF USED, SHALL NOT EXCEED 1% OF THE WEIGHT OF CEMENT.
      f. MEMBRANE FORMING CURING COMPOUNDS: ASTM C309.
      g. WATERSTOPS. REFER TO ACI 504 FOR ACCEPTABLE FLEXIBLE WATERSTOP MATERIALS AND INSTALLATION PROCEDURES.

   E. REINFORCMENT.
      a. REINFORCING BARS.
         i. MATERIALS: SHALL BE ASTM A 615 GRADE 60.
         ii. FABRICATION: IN ACCORDANCE WITH ACI 315.
         iii. COVER:
            1. DEPOSITED AGAINST EARTH   3"
            2. FORMED AGAINST EARTH   2"
            3. INTERIOR SURFACES   3/4"
            4. IN ALL CASES, NO LESS THAN THE BAR DIAMETER OR MAXIMUM AGGREGATE SIZE.
         iv. SPLICES: CONTINUOUS REINFORCEMENT SHALL LAP A MINIMUM OF 40 BAR DIAMETERS OR 18" MINIMUM.
         v. REINFORCEMENT SHALL BE CONTINOUS AROUND CORNERS.
         vi. STAGGER BAR SPLICES.
         vii. MINIMUM LAP SPLICE SHALL BE THE GREATER OF 40 BAR DIAMETERS OR 24".
      b. WELDED WIRE FABRIC.
         i. WELDED WIRE FABRIC IS NOT REQUIRED, BUT MAY BE USED IN LIEU OF A FIBER REINFORCED CONCRETE MIX. WHEN USED, THE WIRE SHOULD BE IN THE MIDDLE OR LOWER THIRD OF THE SLAB.
         ii. MATERIALS. ALL WWF SHALL CONFORM TO ASTM A185.
         iii. ALL SLABS ON GRADE SHALL BE REINFORCED WITH EITHER FIBER REINFORCED CONCRETE OR 6X6 W1.4/W1.4 WWF.
         iv. A MINIMUM LAP OF 1' IS REQUIRED BETWEEN SHEETS OF FABRIC.
      c. ANCHOR BOLTS SHALL BE MADE FROM ASTM A36 STEEL.
      d. FASTENERES: ALL BOLTS USED SHALL BE ASTM A307.
   F. PLACEMENT
      a. CONCRETE SHALL NOT BE PLACED ON FROZEN GROUND OR WHEN AMBIENT TEMPERATURE IS BELOW 40 DEGREES FAHRENHEIT.
      b. FOR DISCONTINUOUS PLACEMENT, A CONSTRUCTION JOINT SHALL BE REQUIRED AS SHOWN IN THE PLANS.
      c. CONCRETE SHALL BE PLACED AS NEAR AS POSSIBLE TO ITS FINAL POSITION. CONCRETE SHALL NOT BE VIBRATED INTO PLACE.
   G. FINISHES: CONCRETE SHALL BE CONSOLIDATED USING A VIBRATORY SCREED AND FLOATED AT A MINIMUM. TROWELING IS NOT REQUIRED.
   H. CURING: A MEMBRANE CURING COMPOUND CONFORMING TO ASTM C 309 SHALL BE APPLIED TO ALL HORIZONTAL SURFACES IMMEDIATELY UPON FINISHING IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS. ALTERNATIVELY, CONCRETE MAY BE KEPT MOIST BY FOGGING OR STEAM CURING FOR A MINIMUM OF THREE DAYS. FOLLOW ACI 305 AND ACI 306 FOR HOT AND COLD WEATHER CONCRETING PRACTICES.
   I. JOINTS: SAW CUT CONTRACTION JOINTS SHOULD BE PLACED ACCORDING TO THE LOCATIONS SHOWN IN THE PLANS AS SOON AS POSSIBLE AFTER FINISHING.
   J. EPOXY: ANY DRILLED HOLES IN CONCRETE FOR DOWELS OR OTHER REINFORCEMENT SHALL BE SET USING A HIGH STRENGTH EPOXY CONFORMING TO ASTM C 881. EUCO #452 FROM EUCLID CHEMICAL COMPANY IS ONE APPROVED PRODUCT.
   K. BACKFILL
      a. DO NOT BACKFILL WALLS UNTIL PRECAST BEAMS AND SLATS ARE IN PLACE AND FULLY GROUTED, AND THE WALLS HAVE CURED FOR AT LEAST 14 DAYS.
      b. ANY ON-SITE SOIL CAN BE USED AS BACKFILL EXCEPT HIGHLY PLASTIC CLAY AND ANY EXPANSIVE SOIL. REPLACE THESE SOILS WITH SANDY AND GRAVELLY SOILS TO RELIEVE PRESSURE AGAINST WALLS.

4. FOUNDATIONS
   A. ALL FOUNDATIONS SHALL BE FREE FROM LOOSE, DELITERIOUS MATERIAL PRIOR TO PLACEMENT OF CONCRETE



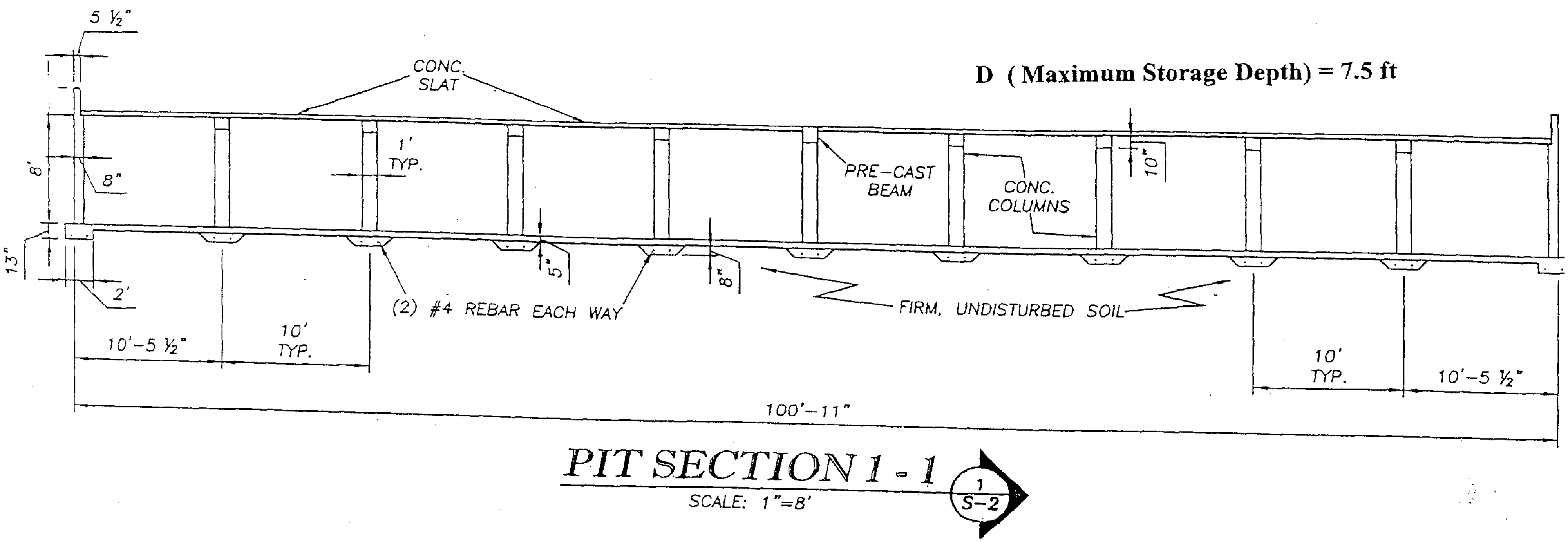
PIT FLOOR AND FOUNDATION PLAN

TOSH FARMS

FLOOR PLAN | NUMBER: S-1

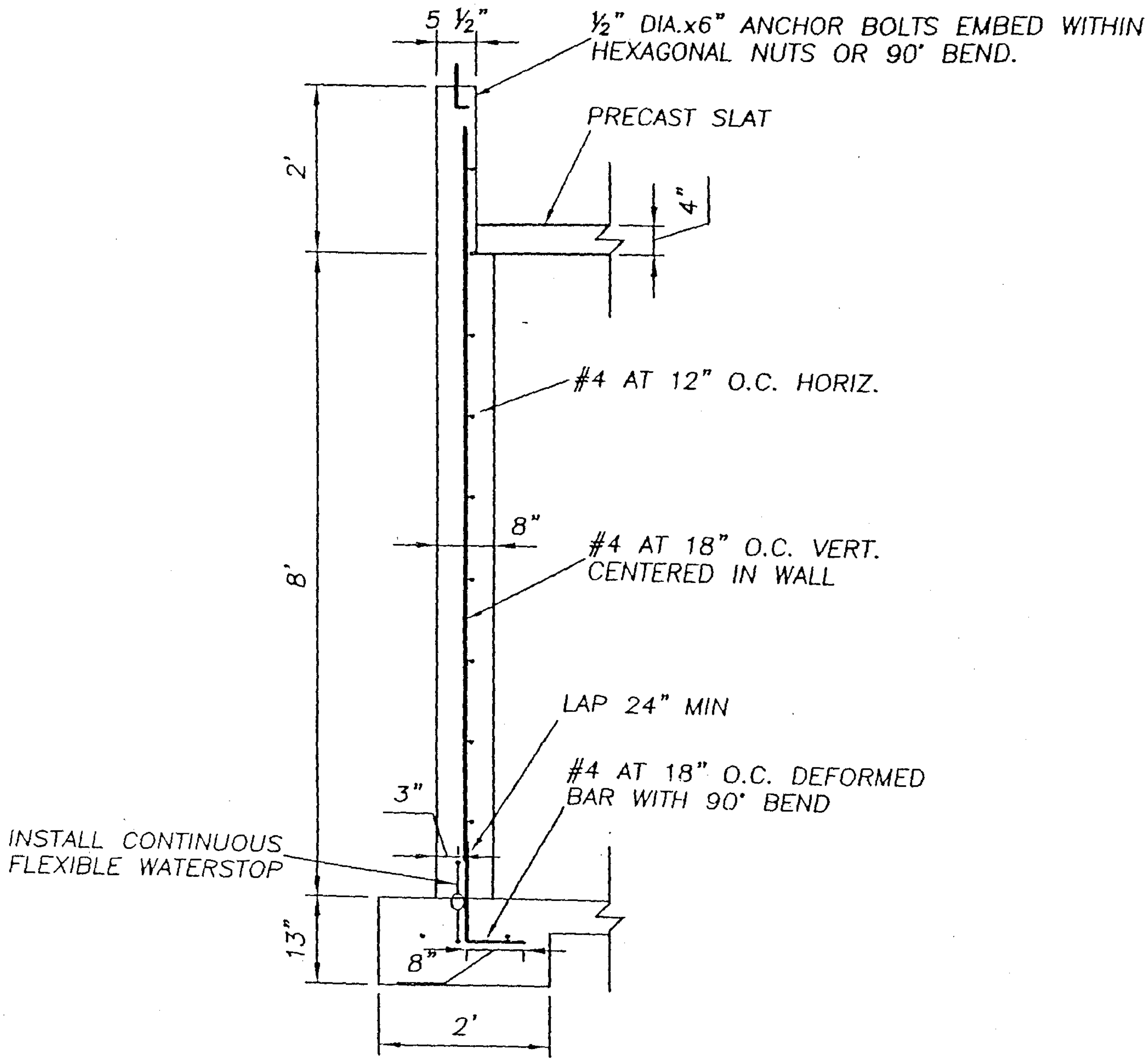
L. L. SMITH & ASSOCIATES

D (Maximum Storage Depth) = 7.5 ft



PIT SECTION 1 - 1

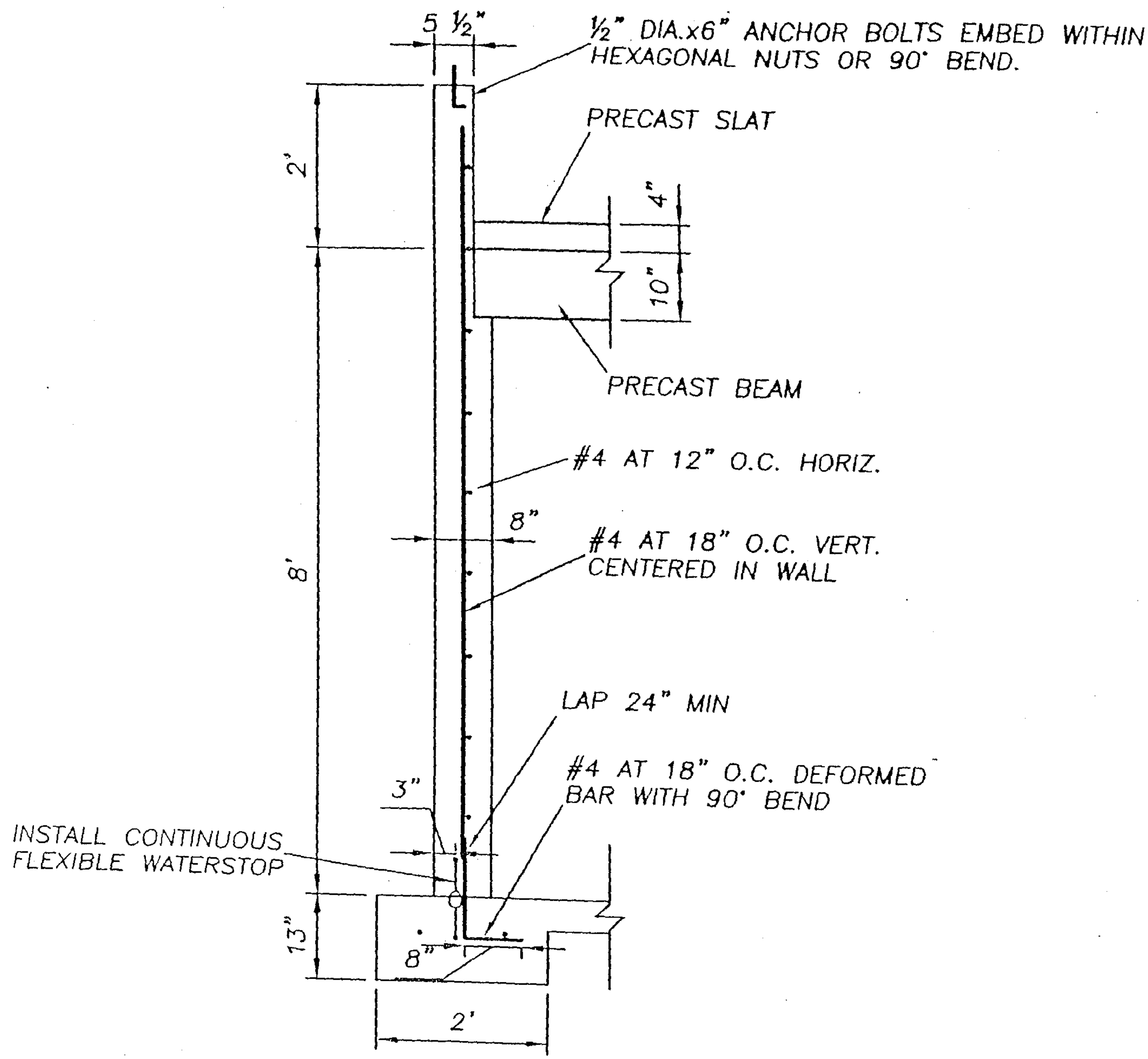
SCALE: 1"=8'



PIT WALL DETAIL

NO SCALE

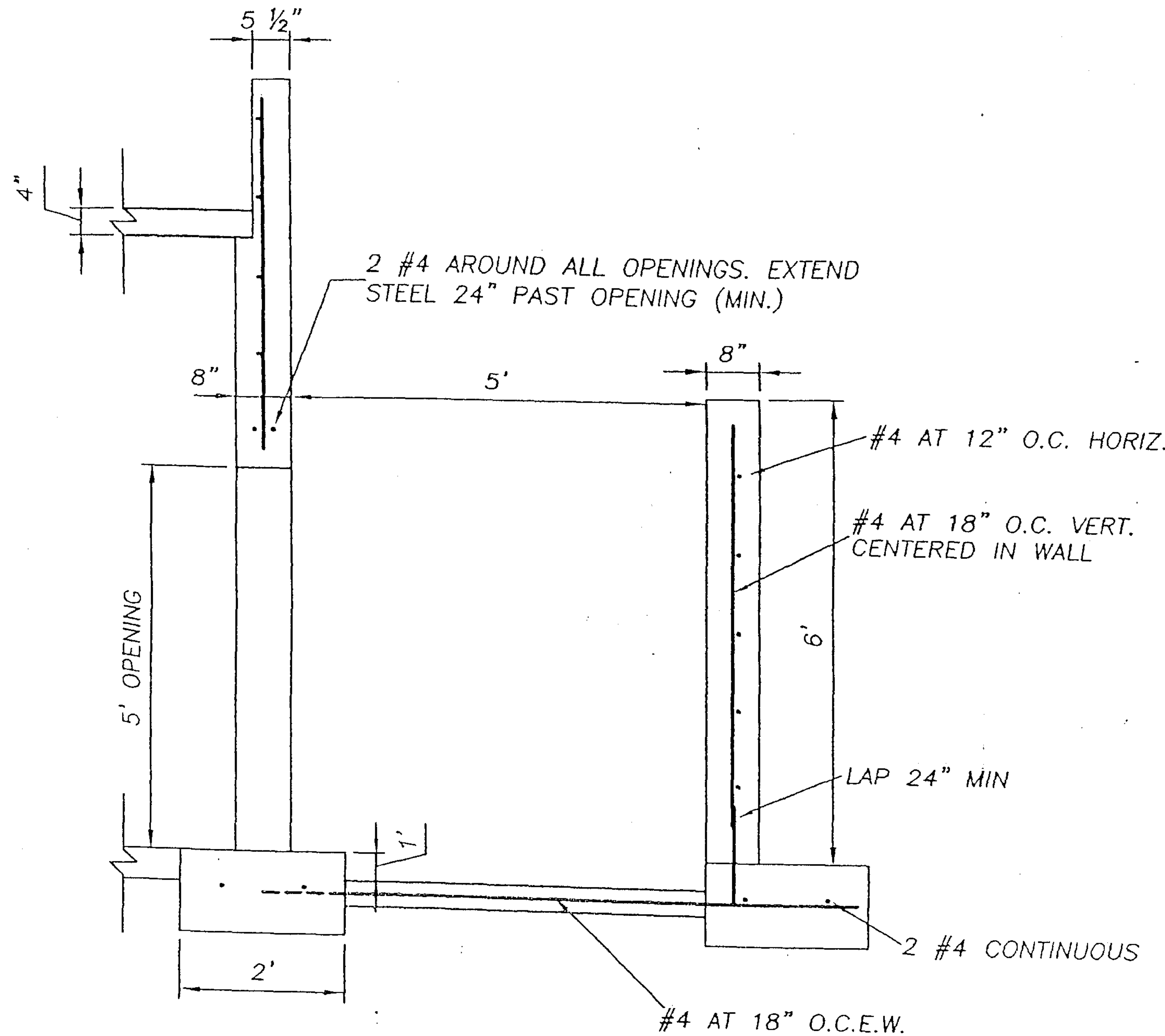
2
S-2



PIT WALL DETAIL

3
S-2

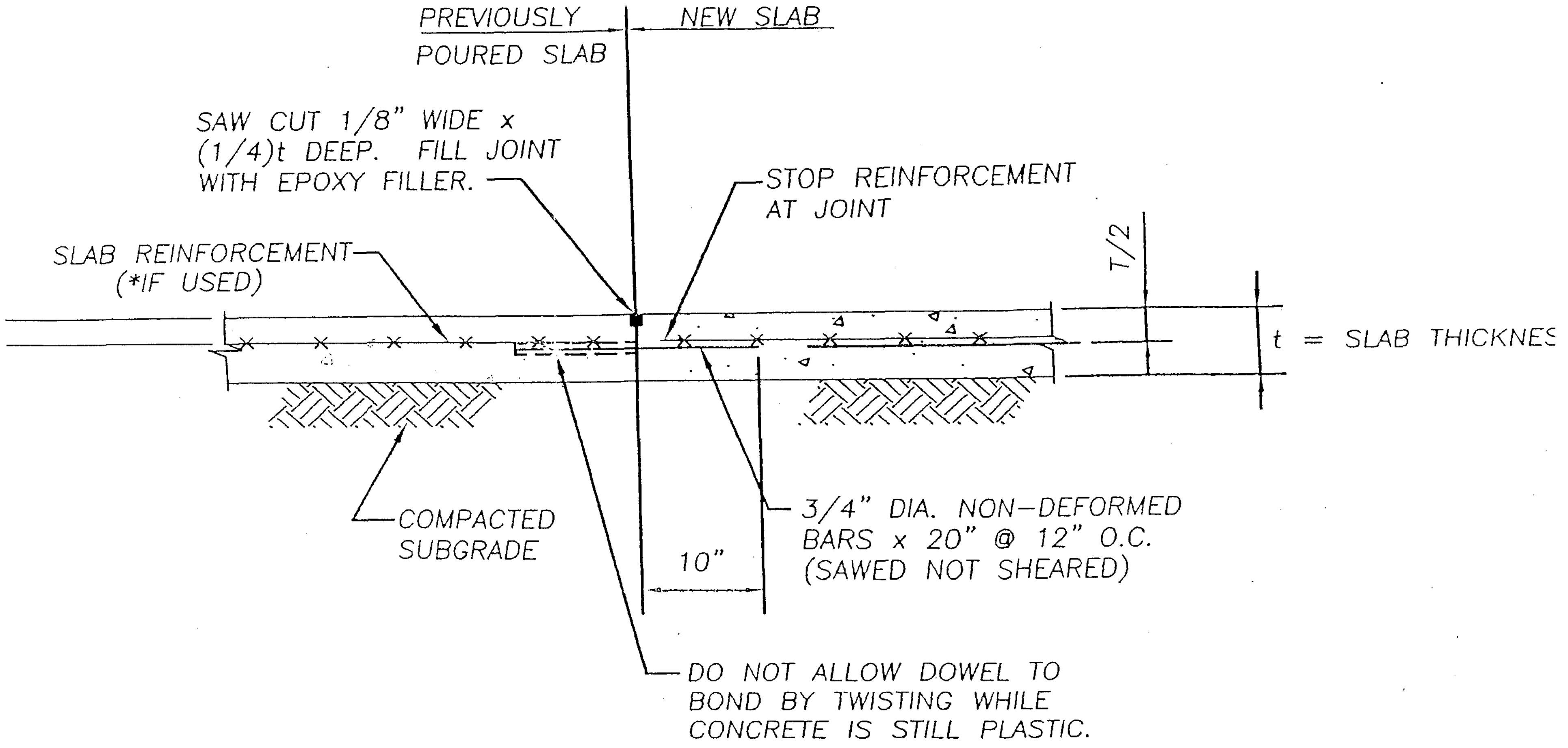
NO SCALE



SUMP PIT DETAIL

NO SCALE

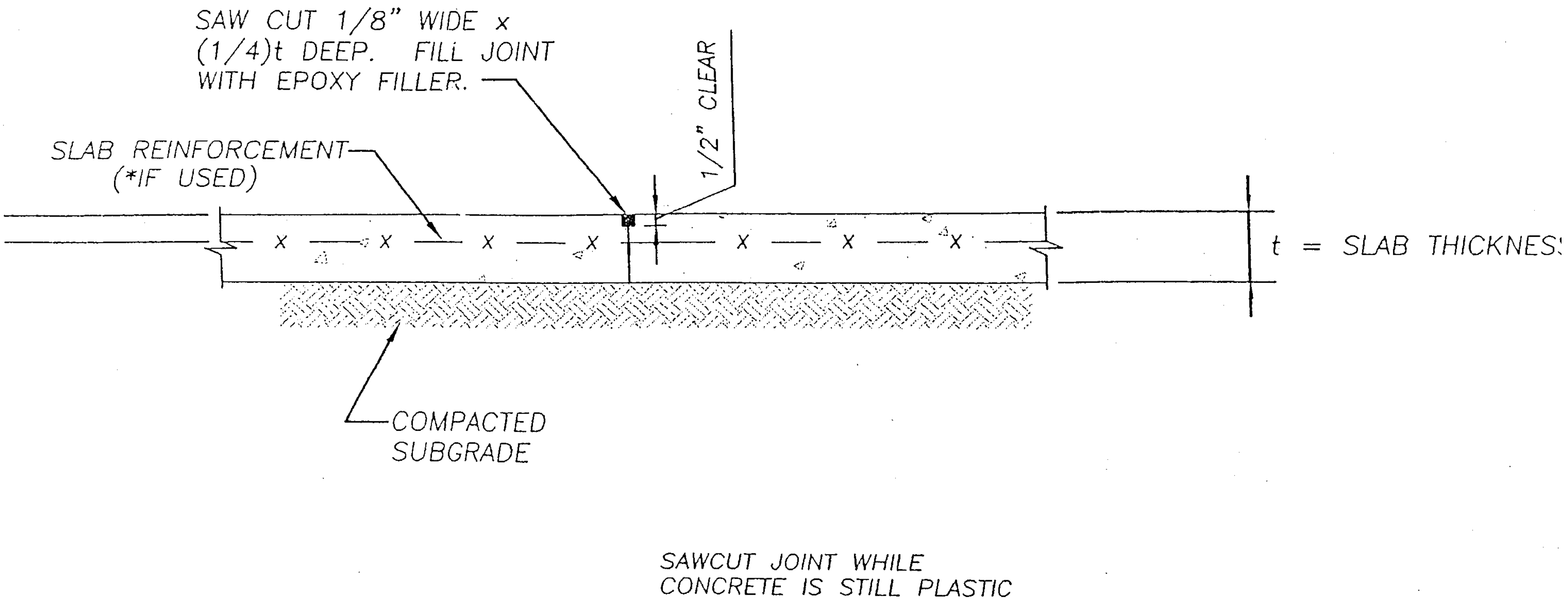
5
S-2



SLAB CONSTRUCTION JOINT DETAIL

6
S-2

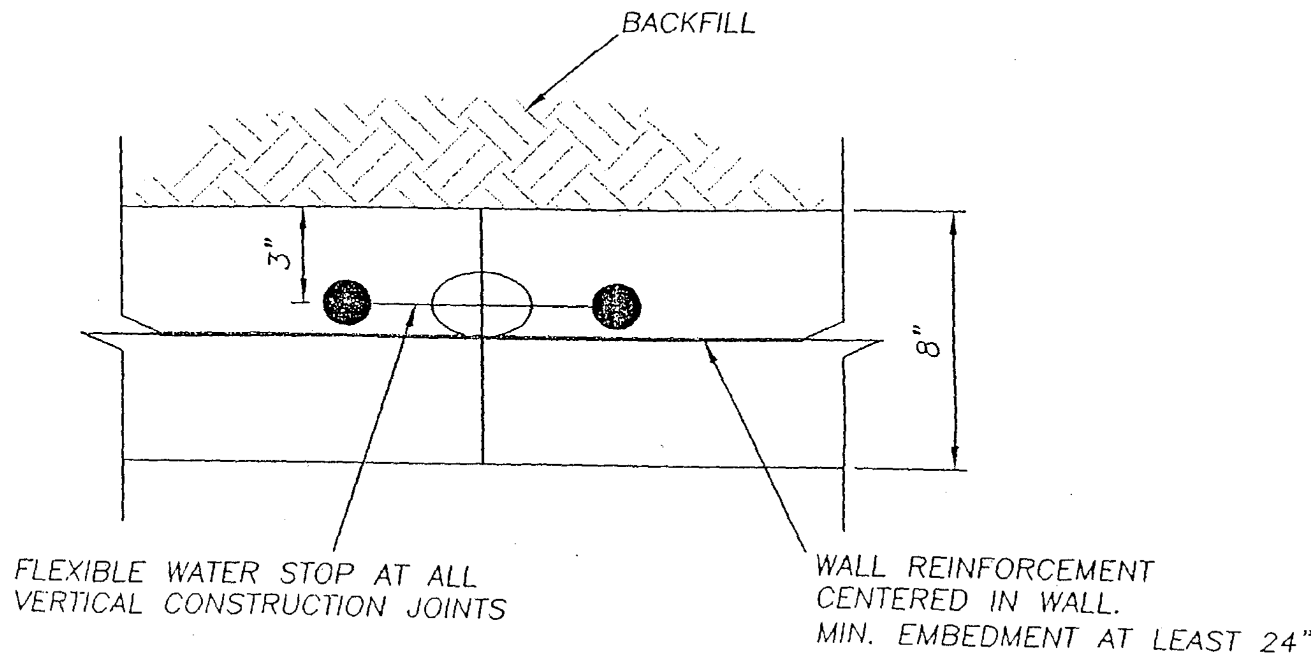
N.T.S.



SLAB CONTRACTION JOINT DETAIL

7
S-2

N.T.S.



WALL CONSTRUCTION JOINT DETAIL

8
S-2

N.T.S.

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN

(CNMP)

FOR

Kenneth Rust

Sept 2008

APPENDIX B

Appendix B - Page 1 " Tosh Farms Two (2) barn system Flow Chart"

Spring 2009

4960 Head
Wean to finish
Average Wt
130 lbs

↓

360 Days of Storage

↓

Spring 2010
278,640.4 cu.ft
8707.51 tons
(2,089,803 gallons)

→ [illegible]

360 Days of Storage

↓

Spring 2011
278,640.4 cu.ft.
8707.51 Tons
(2,089,803 gallons)

→ [illegible]

↓

360 Days of Storage

Spring 2012, and 2013
Begin Cycle again, continue to Soil Test and apply
Nutrients according to Option 1 or Option 2 of KY
NRCS FOTG Standard 590

→ ↑ ←

Appendix B –Page No.2 --Estimating Animal manure Generated Per Confinement Period

Part A. Calculation of Animal Unit Days

(A) Animal Type	(B) Number	(C) Waste as Liquid	(D) Average Weight	(E) Lbs per Animal Unit	(F) Confinement Period (days/yr)	(G) Animal Unit Days
Swine Wean to Finish	4960	100%	130.0	1000	345	222,456

A. Weaning Pigs arrive at approximately 15.0 lbs and depart at approximately 260.0 lbs
B. Two Tosh Farm Barns with planned population of 2,480 head.
C. All Swine Manure and water generated during cleanout will be collected in pits beneath slated floors
D. Average Weight – See growth Curve documentation generated by Doug Overhults, U.K. Ag Engineer Specialist
E. Animal Unit = 1000.0 lbs live weight
F. 345 Days was derived from 335 Days (@ 100% Capacity) + 10 Days (20 days @ 50% capacity) + 10 days Empty
G. (B x D) / E x F = Animal Unit Days

Part B. Manure Generated (As Excreted)

Animal Unit Days	(H) Manure per A.U. KYFOTG 590 Table 1	(I) Volume Manure Cu. Ft.	(J) Volume Manure Tons	(K) Volume Manure Gallons
222,456 A.U.D.	*1.15 cu.ft / A.U.	255,824.40 cu. ft.	7994.5 tons	1,918,683 gallons

H. 1.15 cu. ft. per A.U. varies from 1.70 cu. ft. per A.U. found in KYFOTG 590 table 1.* This new factor of 1.15 cu. ft. per A.U. was determined as being more accurate during joint meeting of KY NRCS Ag Engineers, U.K. Extension Ag Engineers, U.K. Swine Specialist, and Tosh Farms Representatives held on 12-20-2005. Contact Doug Ovehults, U.K. Extenion,Ag Engineeing specialist to verify.
I. Total volume of liquid manure expressed in Cubic Feet. (1 cu. ft. of Liquid manure = 62.5 lbs or 7.5 gallons per cu. ft)
J. Tons of Manure = Cu. Ft. x 62.5 lbs/cu. ft / 2000 lbs/ton
K. Gallons of Manure = (cu. ft. x 7.5 gallons per cu. ft)

Part C. Water Added by Flushing, Wastage, or Cleaning

(L) Gal/head/day	(M) No. Head	(N) Days confinement	(O) Gallons Added	(P) Cu. Ft. Added	(Q) Tons Added
*0.1 gal/head/day	4960 head	345 days	171,120 gallons	22,816 cu. ft	713 tons

L. 0.1 gal/head/day was determined to be more accurate during joint meeting of KY NRCS Ag Engineers, U.K. Extension Ag Engineers, U.K. Swine Specialist, and Tosh Farms Representatives held of 12/20/2005. Contact NRCS State Engineer, Billy Hartsel to verify.
O. Gallons added = L x M x N
P. Cu. ft = O (Gallons) divided by 7.5 (gallons per cu. ft)
Q. Tons = P (cu. ft) x 62.5 (lbs cu. ft) divided by 2000 (lbs per ton)

Part D. Total Volume of Liquid Manure estimated to be Generated Per Confinement Period

(R) Total Volume Manure Generated (cu. ft)	(S) Total Volume Water Added (cu. ft)	(T) Total Volume Liquid Waste Generated (R+S) (cu. ft)	(U) Total Volume Liquid Waste Generated (Tons)	(V) Total Volume Liquid Waste Generated (Gallons)
255,824.40 cu. ft	22,816 cu. ft	278,640.4 cu. ft	8,707.5 tons	2,089,803.0 gallons

R. Total cu. ft manure from column I
S. Total cu. ft water added from column P
T. Total of R + S
U. Total volume generated in cu. ft (column T) X 62.5 (lbs per cu. ft) divided by 2000 (lbs per ton)
V. Total volume generated in cu. ft (column T) x 7.5 (gallons per cu .ft)

University of Kentucky
Manure Test Report

Division of
Regulatory Services

Lexington Lab
606-257-7355

CARLISLE County Extension Office

Owner

Charlie Cannon
980 St. Rt. 1772
Arlington KY 42021
270-655-5641

Sample Identification

UK Lab No 91612	County Code 39
County ID 1	Owner ID 0001
Received 11/9/2005	Reported 11/17/2005

Manure Type: Swine Liquid

APPENDIX B Page 3

Nutrient Results *(in lbs/1000gal)*

N	41	Zn	0.63
P2O5	32	Cu	0.25
K2O	28	Mn	0.24
Ca	10		
Mg	7		

41-32-28 per 1000 gallons = 4.17 tons
9.8 - 7.7 - 6.7 per ton

Nutrient	Injection. Availability Coefficient	Plant Available Lbs/1000 gal	Plant Available lbs/Ton
Nitrogen _N	0.60	24.6 lbs	5.88 lbs
Phosphorus P205	0.80	25.6 lbs	6.16 lbs
Potassium K20	1.00	28.0 lbs	6.7 lbs

Carla Croasey
Extension Agent

Information on land applying manure can be found in UK Extension publications ID-123, AGR-146 and 146A (poultry litter), and ASC-80 (swine manure).

Animal waste must be registered with the Division of Regulatory Services before being sold or offered for sale as a fertilizer.

For registration information contact: Dr. Dave L. Terry, Coordinator of Fertilizer Regulatory Program, University of Kentucky, 103 Regulatory Service Bldg,

Appendix B - Page. 4 Estimating Nutrients Generated Per Confinement Period of Two Barn Tosh Farm Deep Bit Facility

Part A. Estimated total Nutrients Generated

(A) Total Volume Liquid Waste Generated (Gallons)	(B) Nutrient	(C) U.K. Manure Test Report (lbs per 1000 gallons)	(D) Total Nutrients Generated (Lbs)
2,089,803.0 Gallons **Gallons/1000 = 2089.803**	Nitrogen (N)	41.0 lbs	85,681.92 lbs
	Phosphorus (P205)	32.0 lbs	66,873.69 lbs
	Potassium (K20)	28.0 lbs	58,514.48 lbs
	Calcium (Ca)	10.0 lbs	20,898.03 lbs
	Magnesium (Mg)	7.0 lbs	14,628.62 lbs
	Zinc (Zn)	0.63 lbs	1,316.58 lbs
	Copper (Cu)	0.25 lbs	522.45 lbs
	Manganese (Mn)	0.24 lbs	501.55 lbs

A. Total volume Liquid Waste Generated in Gallons comes from worksheet 1, column V.
B. Nutrients analyzed by University of Kentucky Laboratory.
C. See attached University of Kentucky Manure Test Report from C. Cannon dated 11/05
D. Total nutrients generated = (A) divided by 1000 x (C)

Part B. Estimated Total lbs of Available Nitrogen, Phosphorus and Potassium if applied to Cropland planted to Corn.

(E) Nutrient	(F) Management	(G) Availability Coefficient	(H) Total Available Nutrients (lbs)
Nitrogen	Spring applied Injected or Incorporation 2 days or less	0.60	**51,409.15 lbs**
Phosphorus	Spring applied Injected or Incorporation 2 days of less	0.80	**53,498.95 lbs**
Potassium	Spring applied Injected or Incorporation 2 days of less	1.00	58,514.48 lbs

E. Primary Plant Nutrients utilized by Corn, wheat and soybeans and Forage.
F. Swine waste will be injected
G. Source of Availability coefficient is KYFOTG Standard 590, Appendix A, Table 3.
H. Total available nutrients for crop use is determined by multiplying (D x G)=H

Part C. Estimated Total lbs of Available Plant Nitrogen, Phosphorus and Potassium if Surface Applied to Grass land. (Pasture and/or Hay)

(E) Nutrient	(F) Management	(G) Availability Coefficient	(H) Total Available Nutrients (lbs)
Nitrogen	Surface Applied on Pasture and/or Hay land	0.80	**68,545.54 lbs**
Phosphorus	Surface Applied on Pasture and/or Hay land	0.80	**53,498.95 lbs**
Potassium	Surface Applied on Pasture and/or Hay land	1.00	**58,514.48 lbs**

Appendix B – Page 5 "Flow Chart to Determine Nutrient Based Plan

Soil Samples collected from each field tested using Mehlich III method. To determine It was determine existing residual Soil Test Phosphorus (STP)

(See Appendix E –Landowner records -- Soil Test by Field)

↓

When Soil Test Phosphorus (STP) levels are less than 400 lbs/ac

A Nitrogen (N) based plan will be implemented to meet the nutrient needs according to University of Kentucky Fertilizer recommendation AGR-1. (See KYFOTG Standard 590 option # 1)

↓

Application Year 2 and beyond
Soil samples from each field will be analyzed.

If STP levels are still less than 400 lbs per acre then;
Option # 1 -- (Nitrogen based plan) will continue be implemented.

↓

Application Year 2 and beyond
If STP levels are greater than 400 lbs per acre, then;
KY NRCS FOTG 590 Option # 2, Kentucky Phosphorus Index Rating will be used to determine nutrient application rates.

↓

NRCS Phosphorus Index Rating
Low Risk (< 30 points) – (N) Based application continued
Medium Risk (30-60 points) – (N) Based application continued
High Risk (61 to 112 points) – (P) Based Crop Removal only
Very High Risk (>112 points) – NO APPLICATION

↓

Fields with High to Very High Phosphorus Index Rating – NO APPLICATION
And/or
Fields with Soil Test Phosphorus (STP) level reaching 1066 lbs/ac
NO APPLICATION!

Appendix B - Page No. 6cwb - Estimating Cropland needed to Utilize Nutrients

Part A. Agronomic Utilization of Animal Manure

Primary Crop that animal manure will be applied to meet nitrogen recommendations based on AGR-1 is;	**Corn**

Corn yield of 140.0 bu/ac will be used, based on 5 year Average for Marshall Co., source of data N.A.S.S.

Other crops grown in rotation that will also remove applied nutrients are; (Crop Removal rates based on NRCS KYFOTG 590)	**Wheat & Soybeans**

55 bu/ac Wheat yield and 35 bu/ac Bean yield will be used, based on 5 year average for Carlisle Co., source of data N.A.S.S.

AGR-1 Table 12 Recommended application of **Nitrogen** (lbs /A) for Corn production in KY.	Soil Drainage Class		
	Well drained	**Mod Well drained**	Poorly drained
Conventional Tillage	100-140	140-175	175-200
Conservation Tillage	125-165	**165 to 200**	

Nitrogen recommendations in Kentucky are not based on soil analysis but AGR-1 recommendations for crop.

(A) Total Available Nitrogen (lbs)	**(B) Planned Amount (lbs/ac) Nitrogen to be applied**	**(C) <u>Corn</u> acreage needed if Nitrogen Based Plan is applied (A/B)**	**(D) Based on Manure analysis Application Rate Gallons per acre**
51,409.15 lbs	165 lbs/ac	311.6 acres	**6,706.7 gallons/ac**

(E) Total Available Phosphorus (lbs)	**(F) Total Available Phosphorus Applied** *(E/311.6 ac)* **(lbs/ac)**	**(G) 140 bu /ac Corn Phosphorus removal (lbs/ac)**	**(H) 55 bu/ac Wheat Phosphorus removal (lbs/ac)**	**(I) 35 bu/ac Beans Phosphorus removal (lbs/ac)**	**(J) Total Phosphorus removed by Corn, Wheat, and Bean Rotation** *(E+F+G)*	**(K) Estimated Available Phosphorus Carryover (J-F) (lbs/ac)**
53,498.95	171.7.0	56.0	27.5 lbs	24.5 lbs	108.0 lbs	+63.7 lbs

(L) Total Available Potassium (lbs)	**(M) Total Available Potassium Applied** *(L/311.6 ac)* **(lbs/ac)**	**(N) 140 bu /ac Corn Potassium removal (lbs/ac)**	**(O) 55 bu/ac Wheat Potassium removal (lbs/ac)**	**(P) 35 bu/ac Beans Potassium removal (lbs/ac)**	**(J) Total Potassium removed by Corn, Wheat, and Bean Rotation** *(N+O+P)*	**(K) Estimated Available Potassium Carryover (K-M) (lbs/ac)**
58,514.48	187.8	49.0	16.5	38.5	104.0	+83.8

Nitrogen based plan was selected base on KY NRCS 590, Phosphorus Index option # 1 no fields have soil test phosphorus (STP) at or above 400 lbs/ acre. Furthermore, there are no field which have a Phosphorus Index greater than a " medium hazard" which also allows Nitrogen based application of animal waste up to 1066 lbs STP.

Appendix B - Page No. 6cb -- Estimating Cropland needed to Utilize Nutrients

Part A. Agronomic Utilization of Animal Manure

Primary Crop that animal manure will be applied to meet nitrogen recommendations based on AGR-1 is;	**Corn**
Corn yield of 140.0 bu/ac will be used, based on 5 year Average for Marshall Co., source of data N.A.S.S.	
Other crops grown in rotation that will also remove applied nutrients are; (Crop Removal rates based on NRCS KYFOTG 590)	**Soybeans**
55 bu/ac Wheat yield and 35 bu/ac Bean yield will be used, based on 5 year average for Carlisle Co., source of data N.A.S.S.	

AGR-1 Table 12 Recommended application of **Nitrogen** (lbs /A) for Corn production in KY.	Soil Drainage Class		
	Well drained	**Mod Well drained**	Poorly drained
Conventional Tillage	100-140	140-175	175-200
Conservation Tillage	125-165	**165 to 200**	

Nitrogen recommendations in Kentucky are not based on soil analysis but AGR-1 recommendations for crop.

(A) Total Available Nitrogen (lbs)	**(B) Planned Amount (lbs/ac) Nitrogen to be applied**	**(C) Corn acreage needed if Nitrogen Based Plan is applied (A/B)**	**(D) Based on Manure analysis Application Rate Gallons per acre**
51,409.15 lbs	165 lbs/ac	311.6 acres	**6,706.7 gallons/ac**

(E) Total Available Phosphorus (lbs)	**(F) Total Available Phosphorus Applied *(E/311.6 ac)* (lbs/ac)**	**(G) 140 bu /ac Corn Phosphorus removal (lbs/ac)**	**(H) 0 bu/ac Wheat Phosphorus removal (lbs/ac)**	**(I) 50 bu/ac Beans Phosphorus removal (lbs/ac)**	**(J) Total Phosphorus removed by Corn,, and Bean Rotation *(E+F+G)***	**(K) Estimated Available Phosphorus Carryover (J-F) (lbs/ac)**
53,498.95	171.7.0	56.0	0.0 lbs	35.0 lbs	91.0 lbs	+80.7 lbs

(L) Total Available Potassium (lbs)	**(M) Total Available Potassium Applied *(L/311.6 ac)* (lbs/ac)**	**(N) 140 bu /ac Corn Potassium removal (lbs/ac)**	**(O) 0 bu/ac Wheat Potassium removal (lbs/ac)**	**(P) 50 bu/ac Beans Potassium removal (lbs/ac)**	**(J) Total Potassium removed by Corn, and Bean Rotation *(N+O+P)***	**(K) Estimated Available Potassium Carryover (K-M) (lbs/ac)**
58,514.48	187.8	49.0	0.0	55.0	104.0	+83.8

Nitrogen based plan was selected base on KY NRCS 590, Phosphorus Index option # 1 no fields have soil test phosphorus (STP) at or above 400 lbs/ acre. Furthermore, there are no field which have a Phosphorus Index greater than a " medium hazard" which also allows Nitrogen based application of animal waste up to 1066 lbs STP.

Appendix B - Page. 7 -- Summary Record of planned application in 2010

Farm ID. (Tract)	Field Numbers That make up crop unit	Total Acres Of Crop Unit	Nitrogen using Crop	Timing Of Waste application	Form of Waste	Application method	Planned Amount(LBS Nitrogen To be Applied Per acre	Gallons per acre of waste required to obtain Nitrogen Needs	Soil Test Phosphorus (STP) for this crop unit (lbs/ac)	NRCS Phosphorus Index Rating For this Crop unit
T-97	9 & 10	121.4 ac	CORN	April - May	Liquid	Injection	165.0 lb/ac	6,706.7 gal/ac	69 lbs/acre	Medium
T-122	1	56.5 ac	CORN	April - May	Liquid	Injection	165.0 lb/ac	6,706.7 gal/ac	133 lbs/acre	Medium
T-488	1,2a,3, 5, & 7	133.7 ac	CORN	April - May	Liquid	Injection	165.0 lb/ac	6,706.7 gal/ac	147 lbs/acre	Medium
		311.6 ac	**Corn**	**April-May 2010**	**Liquid**	**Surface Apply**	**165 lbs/ac Nitrogen**	**Using Flow meter inject at rate of approximately 6,706.7 gallons per acre**		

Appendix B - Page. 8 -- Summary Record of planned application in 2011

Farm ID. (Tract)	Field Numbers That make up crop unit	Total Acres Of Crop Unit	Nitrogen using Crop	Timing Of Waste application	Form of Waste	Application method	Planned Amount(LBS Nitrogen To be Applied Per acre	Gallons per acre of waste required to obtain Nitrogen Needs	Soil Test Phosphorus (STP) for this crop unit (lbs/ac)	NRCS Phosphorus Index Rating For this Crop unit
T-97	5,6, & 8	271.6 ac	CORN	April - May	Liquid	Injection	165.0 lb/ac	6,706.7 gal/ac	69 lbs/acre	Medium
T-830	1	40.0 ac of 53.0 ac	CORN	April - May	Liquid	Injection	165.0 lb/ac	6,706.7 gal/ac	52 lbs/acre	Medium
		311.6 ac	**Corn**	**April-May 2011**	**Liquid**	**Surface Apply**	**165 lbs/ac Nitrogen**	**Using Flow meter inject at rate of approximately 6,706.7 gallons per acre**		

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN (CNMP)

FOR

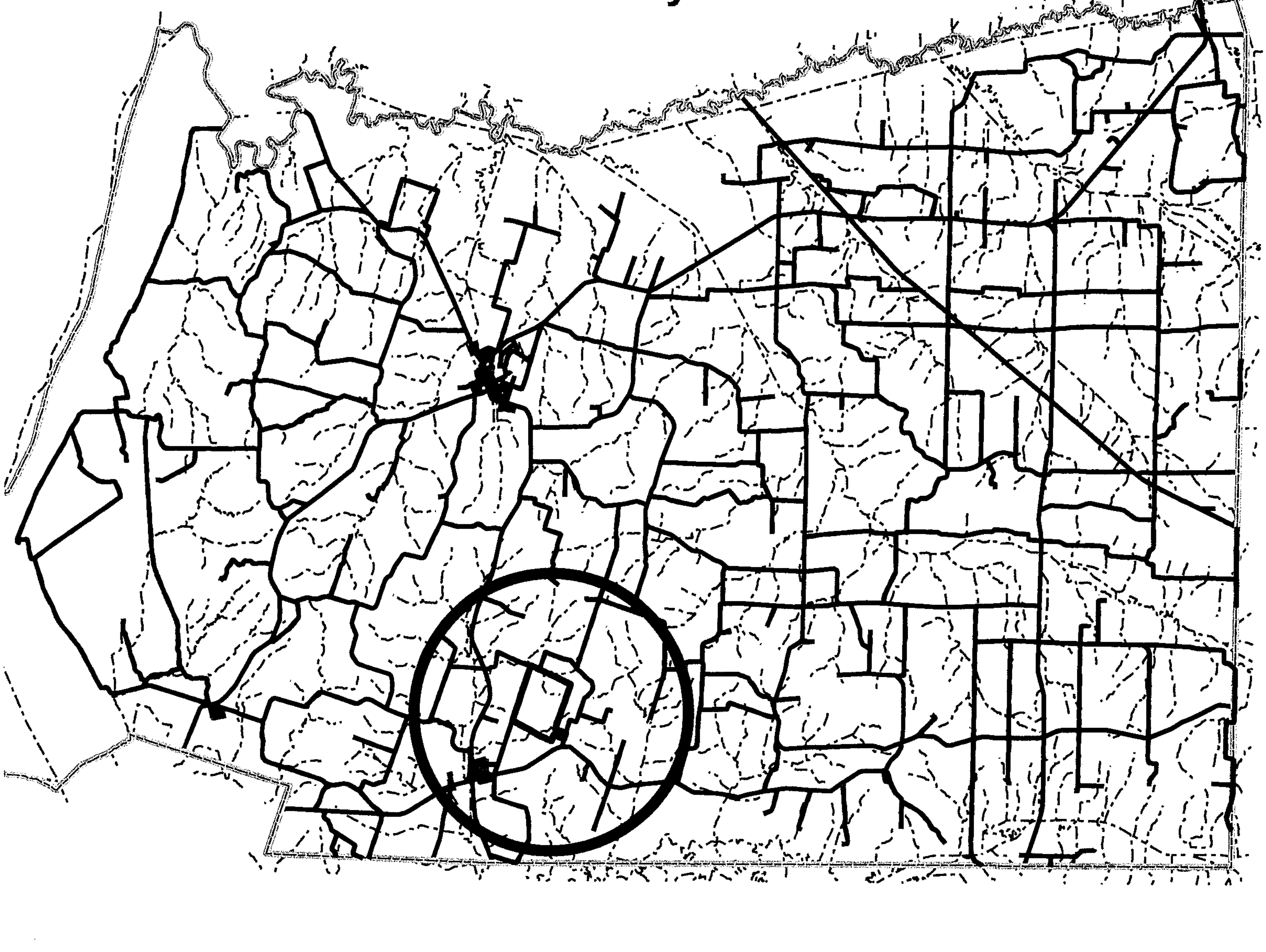
Kenneth Rust

October 2008

APPENDIX C

- Location Maps
- Topographic Maps
- Conservation Plan Maps
- Soil Maps
- Soil Descriptions
- RUSLE2 Worksheets
- Soil Test Reports
- KY NRCS Phosphorus Index worksheets
- Conservation Plan

Carlisle County



Topographic Map

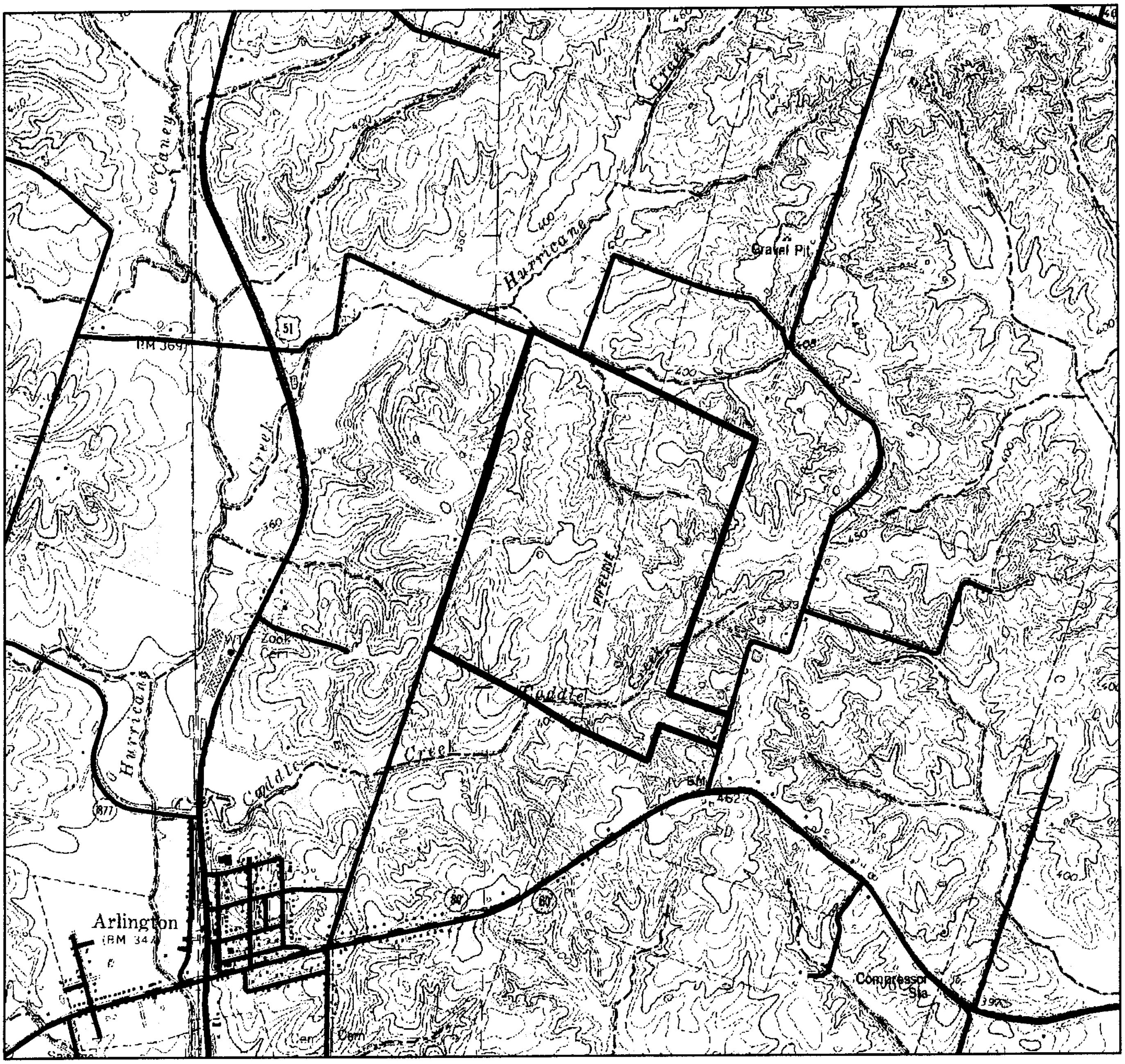
Date: 4/29/2008

Customer(s): JIMMY D RUST

District: Carlisle County

Approximate Acres: 0

Legal Description: FSN-259 T-433



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CONSERVATION PLAN MAP

Date: 4/29/2008

Customer(s): JIMMY D RUST

District: Carlisle County

Approximate Acres: 349.6

Legal Description: FSN-259 T-433

Legend

Tosh Farm Hog Barns (2)

Consplan_T_433

Tract Boundaries

Highway/Roads

Streams

quads24k_a_ky039

1:11,582

N

SOIL MAP

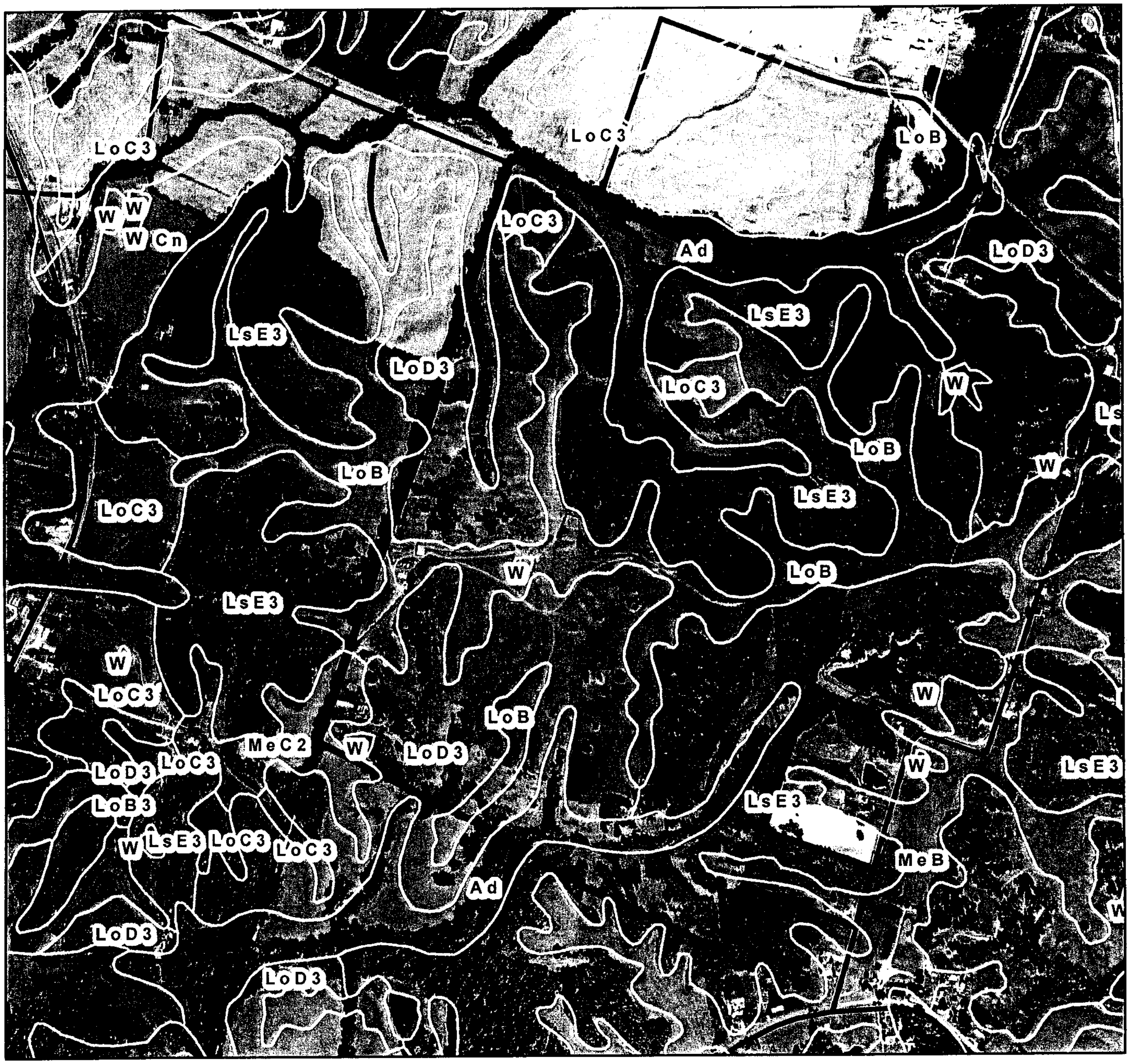
Date: 4/29/2008

Customer(s): JIMMY D RUST

District: Carlisle County

Approximate Acres: 0

Legal Description: FSN-259 T-433



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N

Map Unit Description (Brief)

Carlisle and Hickman Counties, Kentucky

[Only those map units that have entries for the selected non-technical description categories are included in this report]

Map Unit: Ad - Adler silt loam, frequently flooded

Description Category: SOI

Loamy, nearly level bottom soil that is subject to flooding in winter and spring. Seasonal water table at about 2 feet.

Map Unit: LoB - Loring silt loam, 2 to 6 percent slopes

Description Category: SOI

Upland soil that has a fragipan at a depth of about 2 feet that slows water movement and restricts roots. The soil has good workability, moderate yield potential, and is very highly erodible without ground cover.

Map Unit: LoC3 - Loring silt loam, 6 to 12 percent slopes, severely eroded

Description Category: SOI

Upland soil with a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is mostly subsoil due to past erosion. Low yield potential. Best suited to pasture and hay.

Map Unit: LoD3 - Loring silt loam, 12 to 20 percent slopes, severely eroded

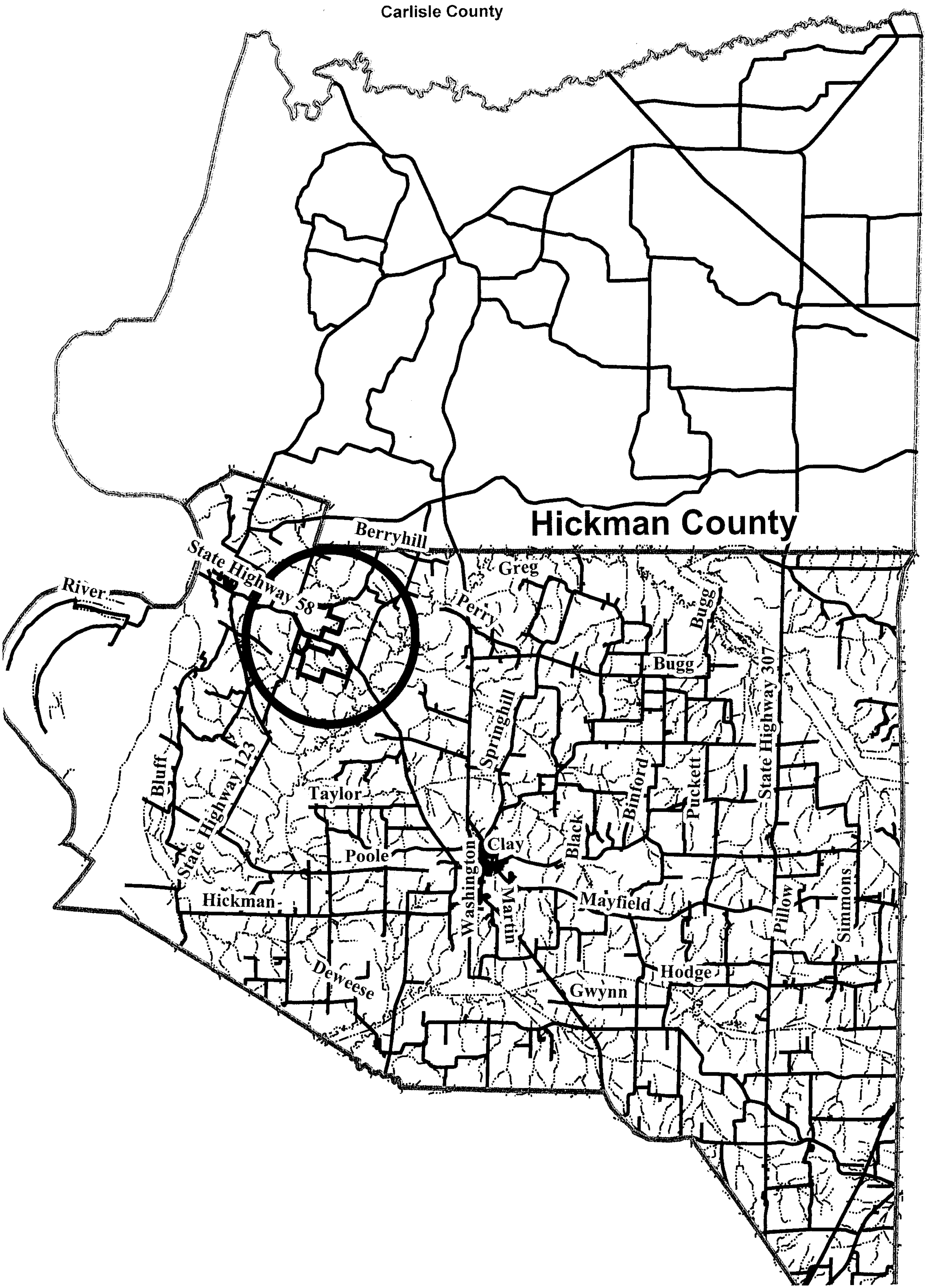
Description Category: SOI

Upland soil that has a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is nearly all subsoil due to past erosion. Yield potential is low. Best suited to pasture and hay.

Map Unit: LsE3 - Loring-Memphis-Saffell complex, 12 to 30 percent slopes, severely eroded

Description Category: SOI

Moderately deep and deep soils on uplands. Fragipan in Loring soils at a depth of about 1 foot slows water movement and restricts roots. Saffell soils are underlain with very gravelly material. The plow layer is nearly all subsoil due to past erosion. Yield potential is low. Best suited to pasture and hay.



Carlisle County
Hickman County
Berryhill
State Highway 58
River
Greg
Perry
Bugg
Bugg
State Highway 307
Springhill
Bluff
State Highway 123
Taylor
Binford
Puckett
Black
Clay
Poole
Washington
Martin
Mayfield
Hickman
Pillow
Simmons
Deweese
Hodge
Gwynn

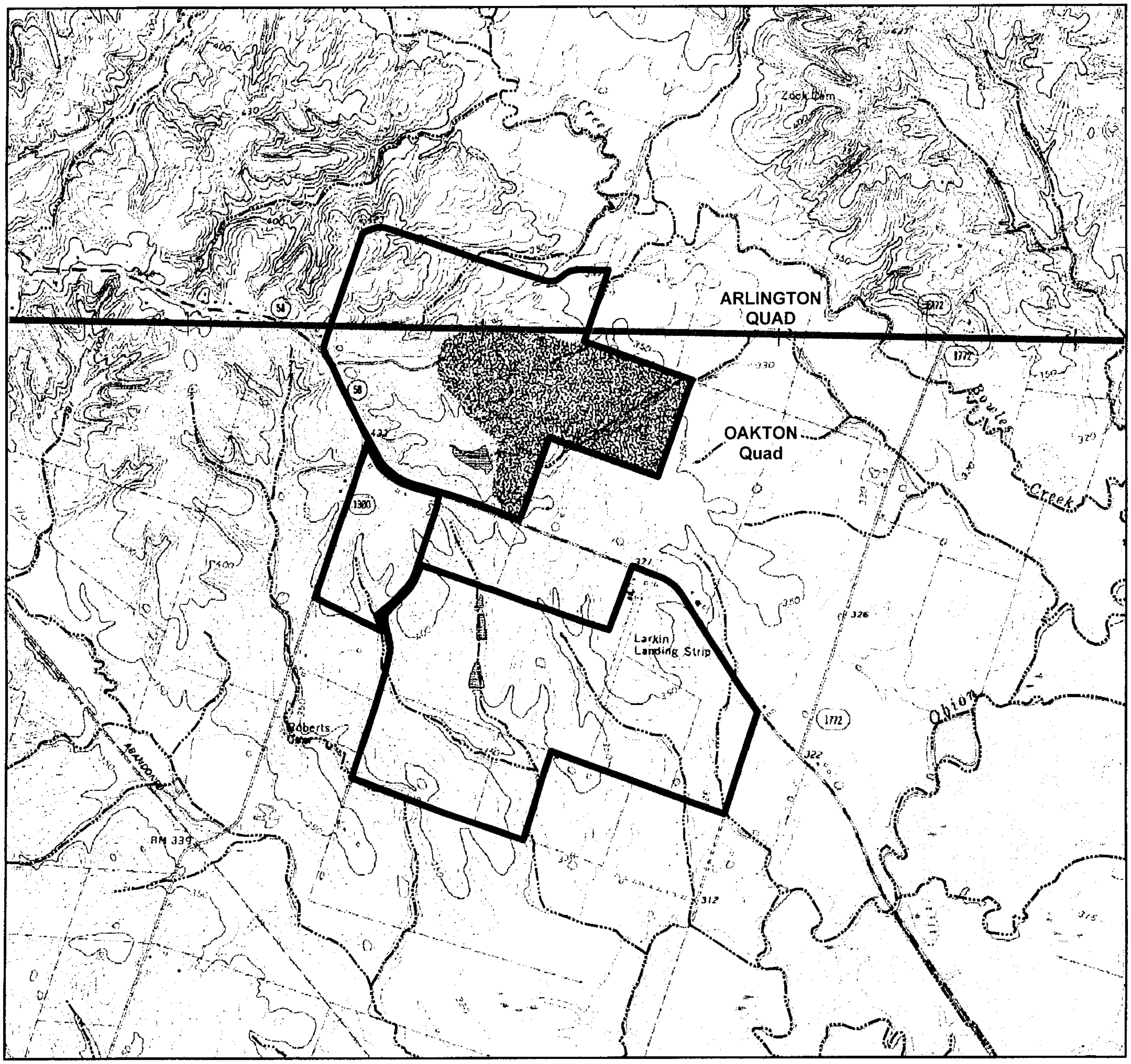
Topographic Map

Date: 4/29/2008

Customer(s): THOMAS R & DOROTHY LARKINS TRUST

Approximate Acres: 0

Legal Description: T-97



N

1:30,808

Conservation Plan Map

Date: 4/29/2008

Landowner: THOMAS R & DOROTHY LARKINS TRUST

Swine Operation: Kenneth Rust

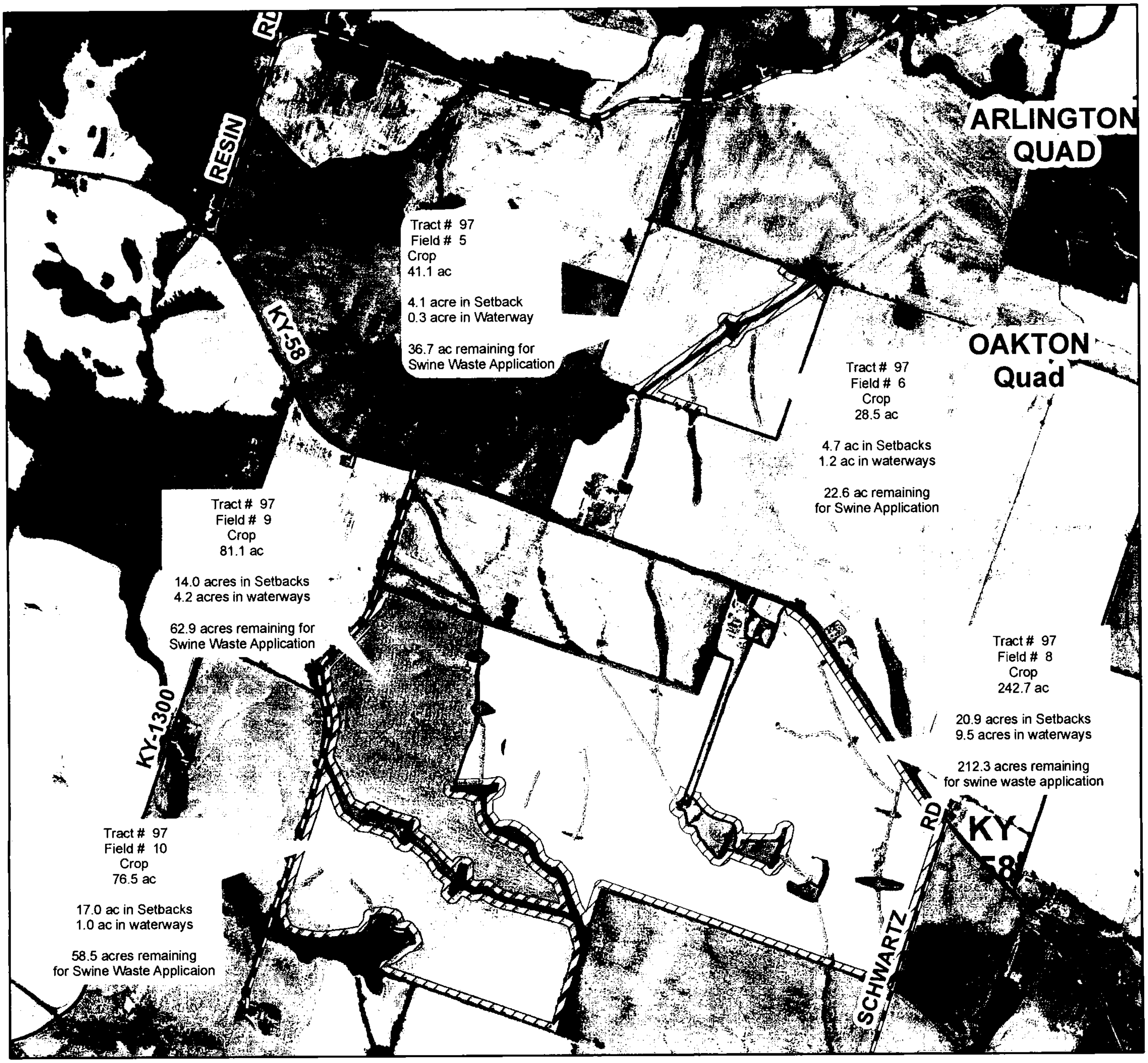
Legal Description: Hickman Co. FSA Tract #-97

Field Office: BARDWELL PROGRAM DELIVERY POINT

Agency: USDA - NRCS

Assisted By: Templeton, Todd C

District: Carlisle Co. Cons District



Legend

- Consplan_T_97
- Grass Waterways
- Concentrated Flow Areas
- 75 Ft Setback
- US HWY
- EXPRESSWAY
- MAJOR ROAD
- Purchase_Local_Roads

1 inch equals 1,500 feet

930 0 930 1,860 2,790 3,720 Feet

N

Soil Map

Date: 4/29/2008

Landowner: THOMAS R & DOROTHY LARKINS TRUST

Swine Operation: Kenneth Rust

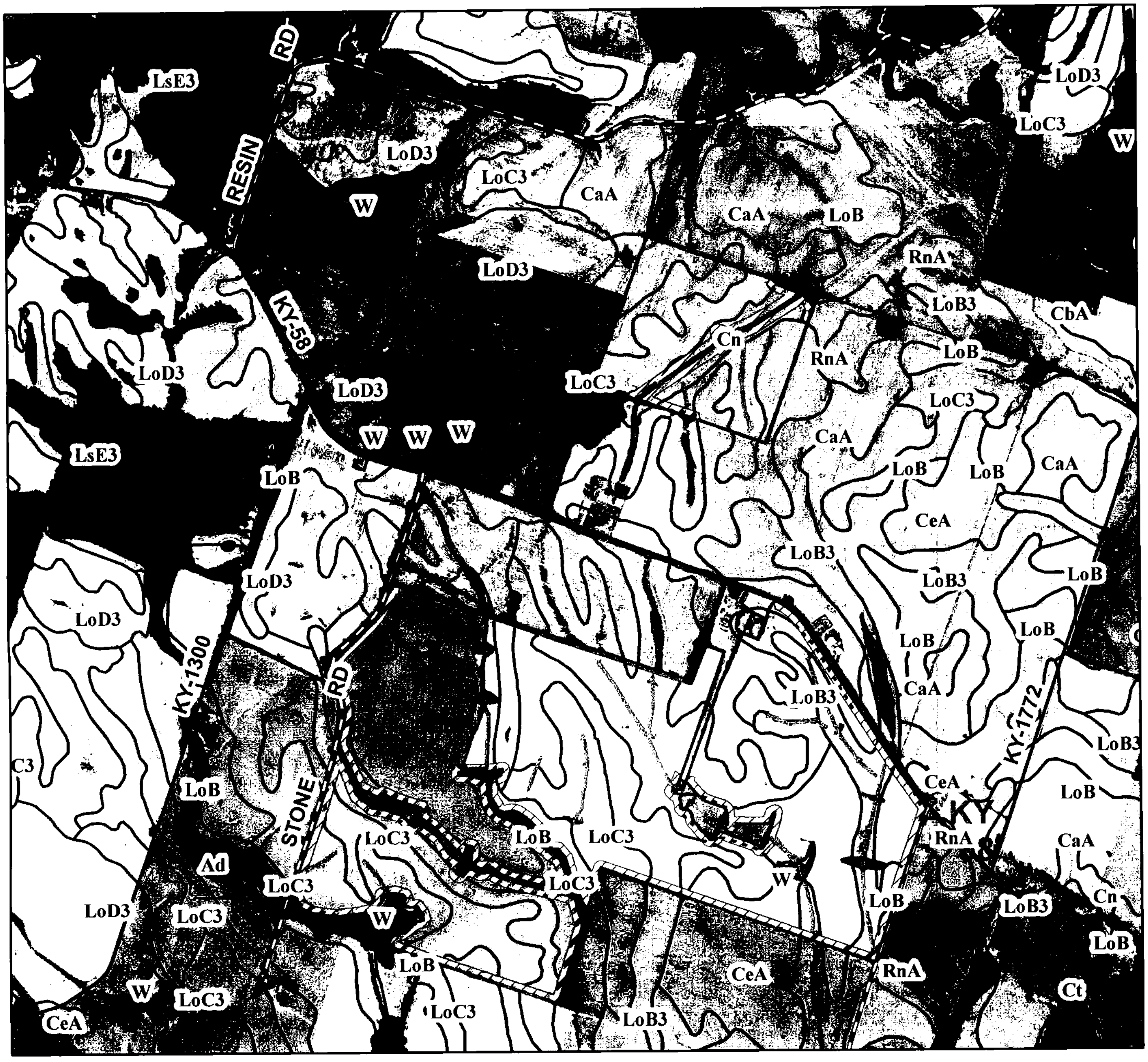
Legal Description: Hickman Co. FSA Tract #-97

Field Office: BARDWELL PROGRAM DELIVERY POINT

Agency: USDA - NRCS

Assisted By: Templeton, Todd C

District: Carlisle Co. Cons District



Legend

- Consplan_T_97
- Grass Waterways
- Concentrated Flow Areas
- 75 Ft Setback
- US HWY
- EXPRESSWAY
- MAJOR ROAD
- Purchase_Local_Roads
- Hickman Co soil_a_ky105

1 inch equals 1,581.143238 feet

1,000 0 1,000 2,000 3,000 4,000 Feet

N

Map Unit Description (Brief)

Carlisle and Hickman Counties, Kentucky

[Only those map units that have entries for the selected non-technical description categories are included in this report]

Map Unit: CaA - Calloway silt loam, 0 to 3 percent slopes

Description Category: SOI

Wet, silty, upland soil with a limited rooting zone and a compact pan at 18 to 30 inches. Moderate yield potential for most row crops.

Map Unit: Cn - Convent-Adler silt loams, frequently flooded

Description Category: SOI

Loamy, nearly level bottom soils that are subject to flooding mostly in winter and spring. Seasonal high water table from 12 to 24 inches.

Map Unit: LoB - Loring silt loam, 2 to 6 percent slopes

Description Category: SOI

Upland soil that has a fragipan at a depth of about 2 feet that slows water movement and restricts roots. The soil has good workability, moderate yield potential, and is very highly erodible without ground cover.

Map Unit: LoB3 - Loring silt loam, 2 to 6 percent slopes, severely eroded

Description Category: SOI

Upland soil that has a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is mostly subsoil due to past erosion. Workability is fair and yield potential is low.

Map Unit: LoC3 - Loring silt loam, 6 to 12 percent slopes, severely eroded

Description Category: SOI

Upland soil with a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is mostly subsoil due to past erosion. Low yield potential. Best suited to pasture and hay.

Map Unit: LoD3 - Loring silt loam, 12 to 20 percent slopes, severely eroded

Description Category: SOI

Upland soil that has a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is nearly all subsoil due to past erosion. Yield potential is low. Best suited to pasture and hay.

USDA NRCS Natural Resources Conservation Service

2009 CTA General

Carlisle County NRCS Field Office

RUSLE2 Field(s) Record

Landuser: Kenneth Rust Hickman County Tract No. 97 Fields 5,6,8,9, & 10 = 393 acres

Inputs:

Location: Kentucky\Carlisle County

Soil: LoC3 Loring silt loam, 6 to 12 percent slopes, severely eroded\Loring silt loam 85%

Slope length (horiz): 150 ft Avg. slope steepness: 8.0 %

Base management: c.Other Local Mgt Records\MT Corn w/injected swine manure + NT Wheat + NT DC Beans

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
4/7/0	Manure injector, liquid low disturb.30 inch		85
4/14/0	Harrow, rotary, light, fluff fragile residue		77
4/15/0	Sprayer, pre-emergence		75
4/15/0	Planter, double disk opnr w/fluted coulter	Corn, grain	75
5/15/0	Sprayer, insecticide post emergence		66
9/22/0	Harvest, killing crop 20pct standing stubble		93
10/10/0	Sprayer, kill crop		91
10/15/0	Drill or air seeder single disk openers 7-10 in spac.	Wheat, winter south 7in rows	91
3/1/1	Fert applic. surface broadcast		80
3/15/1	Sprayer, insecticide post emergence		79
5/7/1	Sprayer, insecticide post emergence		66
6/20/1	Harvest, killing crop 20pct standing stubble		96
6/23/1	Sprayer, kill crop		96
6/23/1	Planter, double disk opnr w/fluted coulter, 15 inch row spacing	Soybean, mw 15 - 20 in rows	96
7/15/1	Sprayer, insecticide post emergence		93
8/15/1	Sprayer, insecticide post emergence		90
9/15/1	Sprayer, insecticide post emergence		86
11/15/1	Harvest, killing crop 20pct standing stubble		95

SOIL LOSS RESULTS:

T value: 3.0 t/ac/yr **Soil loss for cons. plan: 4.9 t/ac/yr**

FUEL USE EVALUATION:

Fuel type for entire run	*Fuel cost for entire simulation, US$/ac*
Diesel	31.0

Soil conditioning index (SCI)	*Avg. annual slope STIR*
0.38	9.19

The **SCI** is the **Soil Conditioning Index** rating. If the calculated index is a negative value, soil organic matter levels are predicted to decline under that production system. If the index is a positive value, soil organic matter levels are predicted to increase under that system.

The **STIR** value is the **Soil Tillage Intensity Rating**. It utilizes the speed, depth, surface disturbance percent and tillage type parameters to calculate a tillage intensity rating for the system used in growing a crop or a rotation. STIR ratings tend to show the differences in the degree of soil disturbance between systems. The kind, severity and number of ground disturbing passes are evaluated for the entire cropping rotation as shown in the management description.

KENTUCKY PHOSPORUS INDEX

Ky. phosphorus index: 54 (See phosphorus Index Worksheet)

Ky field vulnerability: Use Medium

Field Vulnerability for Phosphorus Loss	
Total Points From P Index	**Generalized Interpretations of P index**
< 30	**LOW** *potential for P movement from the field and low probability of an adverse impact to surface water.*
30-60	**MEDIUM** *potential for P movement from the field a moderate probability of an adverse impact to surface water.* When STP rates are less than 800 lbs/ac, these fields may be used to utilize animal waste following Nitrogen based plan only when applying conservation practices such as Crop Rotations, Contour farming, Residue and Tillage Management No-till, with grass waterways. Setbacks and/or Filter Strips are recommended.
61-112	**HIGH** *potential for P movement from the field and high probability of an adverse impact to surface water.* Strict setbacks and conservation practices must be applied. **If application of animal waste is planned, rates should not exceed phosphorus uptake of crop.**
>112	**VERY HIGH** *potential for P movement from the field and an adverse impact on surface water.* **Animal waste should not be applied.**

The Phosphorus index for this field/s is based upon the following **"Planned"** conditions.

- Mehlich 3 soil test P level:= 69 lb/ac
- Application Method =– Injection
- Application Timing =– April 1st through May 5th
- Application Setback from downstream stream/creek/water body = Min of 75 feet
- Downstream Distance to stream/creek/water body = 75 to 100 ft
- Surface cover after application=: 70-75 %
- Watershed impaired due to ag. nutrients?:= No
- In Bluegrass County?:= No

From:
Carlisle County Extension Office
P.O. Box 518
Bardwell, Kentucky 42023

UK COOPERATIVE EXTENSION SERVICE
University of Kentucky – College of Agriculture

Soil Test Report

Lexington 859-257-2785
Princeton 270-365-7541
www.rs.uky.edu/soils

COUNTY SAMPLE NO.: 0215

REPORT FORM: A

To:
Rust, Kenneth
1305 CR 1234
Arlington, KY 42021

Carla Harper
Carla Harper (270)-628-5458
Agent for Agriculture / Natural Resources

Date	Owner Sample ID	Owner ID	County Code	UK Lab NO.
9/22/2008	tract 97	174	39	33604

Nutrient	Lab Results	Level of Adequacy (Very Low / Low / Medium / High / Very High)
Phosphorus (P)	69	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
Potassium (K)	146	>>>>>>>>>>>>>>>>>
Soil pH	6.2	
Buffer pH	7.1	
Calcium (Ca)	3105	
Magnesium (Mg)	209	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
Zinc (Zn)	3.5	
Other Test		

Calculated CEC Data	
CEC (meg/100g):	11
%Base Sat.:	69
%K:	1
%Ca:	61
%Mg:	7
%H:	31

Acres	Primary Crop	Primary Management	Primary Use	Previous Crop	Previous Management	Previous Use	Crop 2 Years Ago Tobacco	Soil Drainage
	Soybeans	No Tillage	Grain	Corn	No Tillage	Grain		Moderate

RECOMMENDATIONS:	N	P2O5	K2O	LIME	Mg	Zn
	See AGR-1	None	See AGR-1	None	None	None

Paid: Yes

COMMENTS:

Mehlich III used for P, K, Ca, Mg, and Zn (lbs/acre). Crop response is highly probable with Very Low or Low soil levels, slight with Medium, and not likely with High or Very High. N, P2O5, K2O, Mg, and Zn recommendations are based on lbs of the nutrient. Fertilizer needed will depend on nutrient content in the fertilizer. Soil pH and Sikora buffer pH are used for determining lime needs based on 100% effective lime. Lime quality in KY is defined by relative neutralizing value (RNV). RNV values for ag lime are determined by the KY Dept of Ag and are on the internet (publications at soils.rs.uky.edu).

No nitrogen is recommended for well-nodulated soybeans.

Inoculate seed planted where soybeans have not been grown in the past 3 to 5 years, or where soybeans had few nodules.

If the pH is below 6.2 at seeding time apply 1 to 2 ounces of sodium molybdate (0.4 to 0.8 ounces of elemental molybdenum) per acre as a seed treatment. If both inoculum and molybdenum are needed, apply inoculum to the seed and broadcast (spray) 1 lb. Sodium molybdate (6.4 oz molybdenum) ahead of final seedbed preparation. Not more that 2 lb sodium molybdate (13 oz molybdenum) per acre should be used during any 5-year period.

KENTUCKY PHOSPHORUS INDEX WORKSHEET

Farm:	0	Date:	October 1, 2008
Tract:	97	[redacted]	

[redacted]		FIELD FEATURE VALUE RATINGS (1,2,4, or 8 points)							
		Field #: 5		Acres: 41.1		Field #: 6		Acres: 28.5	
Field Features	**Weighted Factor (WF)**	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value
1. Hydrologic Soil Group	1	4	4	4	4	4	4	4	4
2. Residual Soil Test (P)	3	1	3	1	3	1	3	1	3
3. Field Slope Percent	1	4	4	4	4	4	4	4	4
4. Land Cover Percent	3	4	12	1	3	4	12	1	3
5. Vegetative Buffer Width	3	8	24	8	24	8	24	8	24
6. Ag. Impaired Watershed	1	1	1	1	1	1	1	1	1
7. Application Timing	3	2	6	2	6	2	6	2	6
8. Application Method	3	8	24	1	3	8	24	1	3
9. Distance To Waterbody	2	8	16	2	4	8	16	2	4
10. MLRA Location	1	2	2	2	2	2	2	2	2
FIELD FEATURES INDEX TOTALS	[redacted]	Existing Total*	**96**	**Planned Total**	**54**	Existing Total*	**96**	**Planned Total**	**54**

Note: If **existing total** results in a **"Low"** or **"Medium"** rating, a nitrogen, or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss

Total Points from P Index	**Generalized Interpretation of P Index**
>30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

KENTUCKY PHOSPHORUS INDEX WORKSHEET

Farm:	0	Date:	October 1, 2008
Tract:	97	[redacted]	

[redacted]

		FIELD FEATURE VALUE RATINGS (1,2,4, or 8 points)							
		Field #: 8	Acres: 242.7			Field #: 9	Acres: 81.1		
Field Features	**Weighted Factor (WF)**	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value
1. Hydrologic Soil Group	1	4	4	4	4	4	4	8	8
2. Residual Soil Test (P)	3	1	3	1	3	1	3	1	3
3. Field Slope Percent	1	4	4	4	4	4	4	4	4
4. Land Cover Percent	3	4	12	1	3	4	12	1	3
5. Vegetative Buffer Width	3	8	24	8	24	8	24	8	24
6. Ag. Impaired Watershed	1	1	1	1	1	1	1	1	1
7. Application Timing	3	2	6	2	6	2	6	2	6
8. Application Method	3	8	24	1	3	8	24	1	3
9. Distance To Waterbody	2	8	16	2	4	8	16	2	4
10. MLRA Location	1	2	2	2	2	2	2	2	2
FIELD FEATURES INDEX TOTALS	[redacted]	Existing Total*	**96**	**Planned Total**	**54**	Existing Total*	**96**	**Planned Total**	**58**

Note: If **existing total** results in a **"Low"** or **"Medium"** rating, a nitrogen, or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss

Total Points from P Index	**Generalized Interpretation of P Index**
>30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

KENTUCKY PHOSPHORUS INDEX WORKSHEET

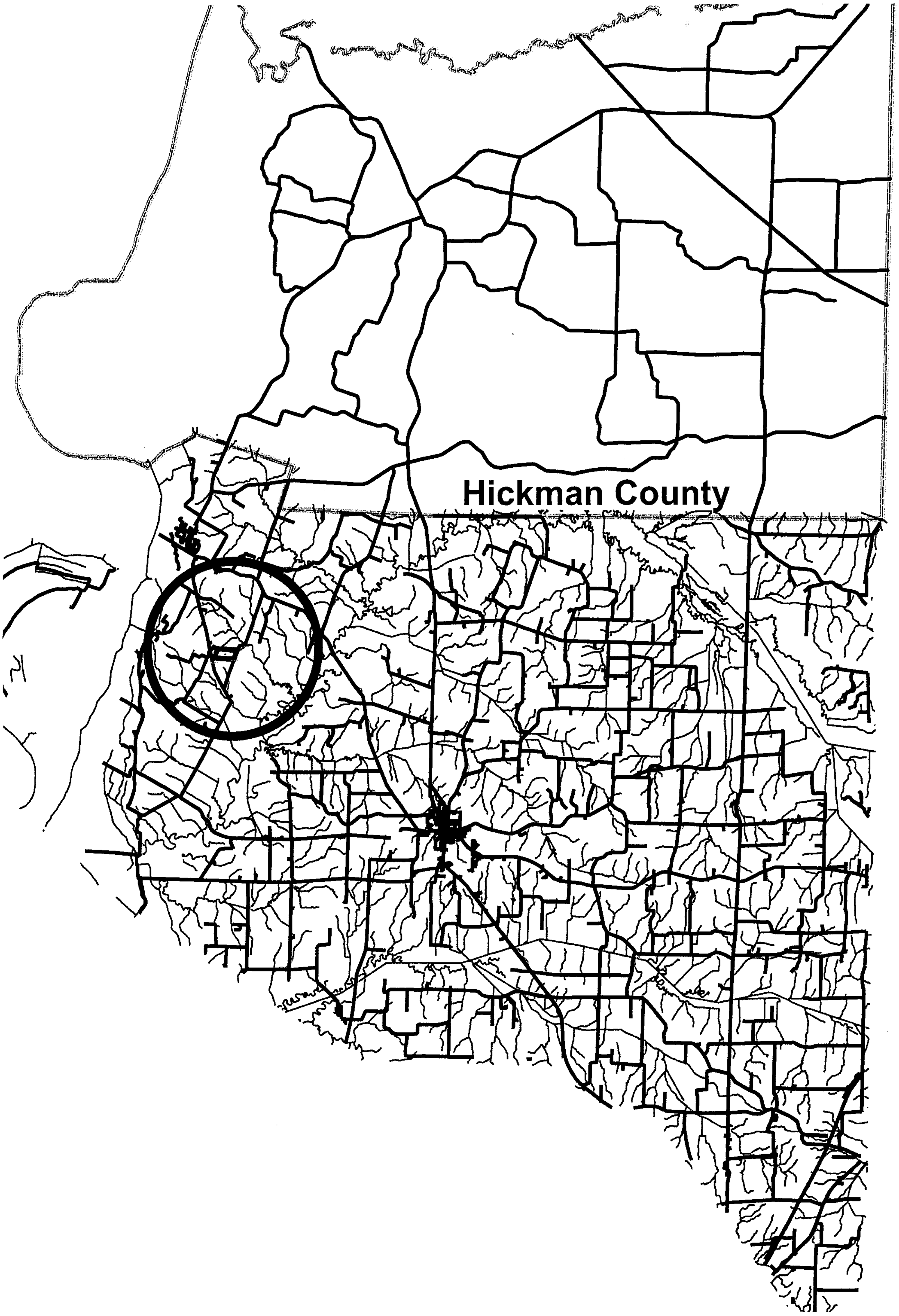
Farm:	0	Date:	October 1, 2008
Tract:	97		

		FIELD FEATURE VALUE RATINGS (1,2,4, or 8 points)							
		Field #: 10 Acres: 76.5				Field #: ____ Acres: ____			
Field Features	**Weighted Factor (WF)**	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value
1. Hydrologic Soil Group	1	4	4	4	4				
2. Residual Soil Test (P)	3	1	3	1	3				
3. Field Slope Percent	1	4	4	4	4				
4. Land Cover Percent	3	4	12	1	3				
5. Vegetative Buffer Width	3	8	24	8	24				
6. Ag. Impaired Watershed	1	1	1	1	1				
7. Application Timing	3	2	6	2	6				
8. Application Method	3	8	24	1	3				
9. Distance To Waterbody	2	8	16	2	4				
10. MLRA Location	1	2	2	2	2				
FIELD FEATURES INDEX TOTALS		Existing Total*	**96**	**Planned Total**	**54**	Existing Total*	**0**	**Planned Total**	**0**

Note: If **existing total** results in a **"Low"** or **"Medium"** rating, a nitrogen, or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss

Total Points from P Index	**Generalized Interpretation of P Index**
>30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.



Hickman County

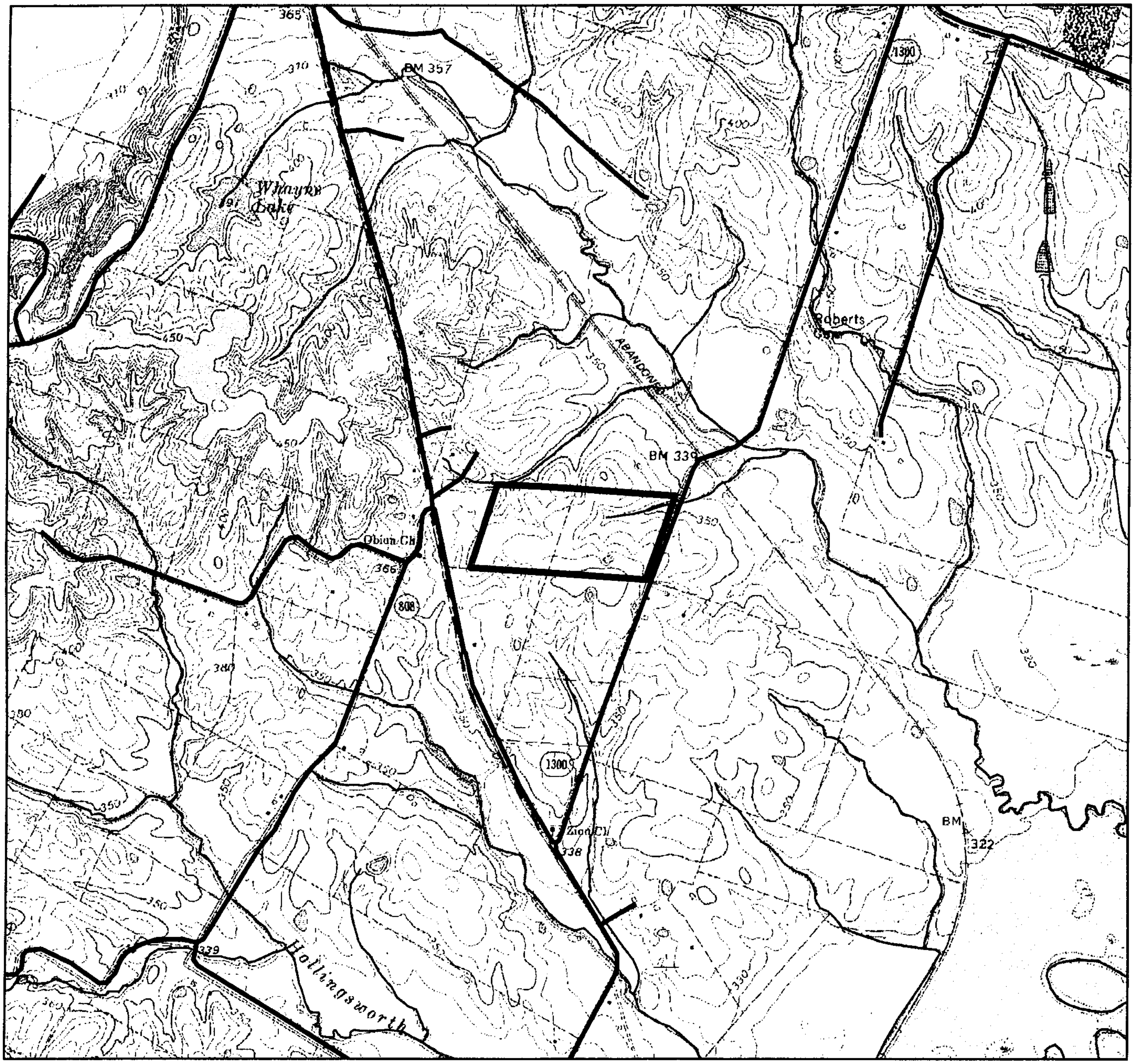
Topographic Map

Date: 4/29/2008

Customer(s): THOMAS R & DOROTHY LARKINS TRUST

Approximate Acres: 0

Legal Description: T_122



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Conservation Plan Map

Date: 8/28/2008

Landowner Thomas R & Dorothy Larkins Trust
Swine Operator - Kenneth Rust

Field Office: BARDWELL PROGRAM DELIVERY POINT

Legal Description: Hickman Co. FSA Tract # 122

Agency: USDA - NRCS

Assisted By: Templeton, Todd C

Legend
- 75 Ft Setback
- Consplan_T_122
- Waterway
- nhd24k_l_ky105
- US HWY
- EXPRESSWAY
- MAJOR ROAD
- Purchase_Local_Roads
- COUNTY LINES

1 inch equals 660 feet

340 0 340 680 1,020 1,360 Feet

N

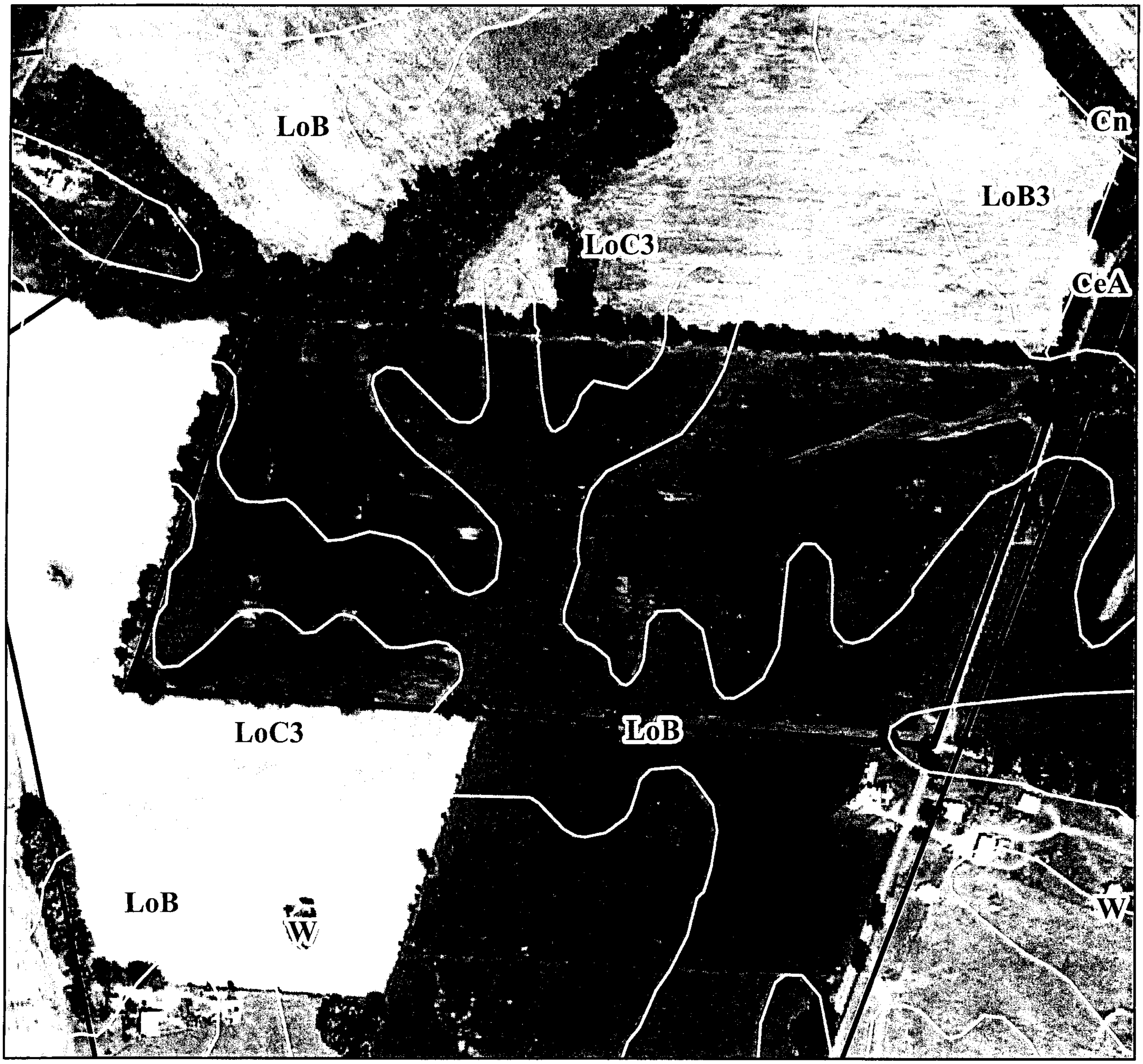
SOIL MAP

Date: 4/29/2008

Customer(s): THOMAS R & DOROTHY LARKINS TRUST

Approximate Acres: 0

Legal Description: T_122



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Map Unit Description (Brief)

Carlisle and Hickman Counties, Kentucky

[Only those map units that have entries for the selected non-technical description categories are included in this report]

Map Unit: LoB - Loring silt loam, 2 to 6 percent slopes

Description Category: SOI

Upland soil that has a fragipan at a depth of about 2 feet that slows water movement and restricts roots. The soil has good workability, moderate yield potential, and is very highly erodible without ground cover.

Map Unit: LoC3 - Loring silt loam, 6 to 12 percent slopes, severely eroded

Description Category: SOI

Upland soil with a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is mostly subsoil due to past erosion. Low yield potential. Best suited to pasture and hay.

USDA NRCS Natural Resources Conservation Service

2009 CTA General

Carlisle County NRCS Field Office

RUSLE2 Field(s) Record

Landuser: Kenneth Rust Hickman County Tract No. 122 Field 1 = 64.1 acres

Inputs:

Location: Kentucky\Carlisle & Hickman County

Soil: LoC3 Loring silt loam, 6 to 12 percent slopes, severely eroded\Loring silt loam 85%

Slope length (horiz): 150 ft Avg. slope steepness: 8.0 %

Base management: c.Other Local Mgt Records\MT Corn w/injected swine manure + NT Wheat + NT DC Beans

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
4/7/0	Manure injector, liquid low disturb.30 inch		85
4/14/0	Harrow, rotary, light, fluff fragile residue		77
4/15/0	Sprayer, pre-emergence		75
4/15/0	Planter, double disk opnr w/fluted coulter	Corn, grain	75
5/15/0	Sprayer, insecticide post emergence		66
9/22/0	Harvest, killing crop 20pct standing stubble		93
10/10/0	Sprayer, kill crop		91
10/15/0	Drill or air seeder single disk openers 7-10 in spac.	Wheat, winter south 7in rows	91
3/1/1	Fert applic. surface broadcast		80
3/15/1	Sprayer, insecticide post emergence		79
5/7/1	Sprayer, insecticide post emergence		66
6/20/1	Harvest, killing crop 20pct standing stubble		96
6/23/1	Sprayer, kill crop		96
6/23/1	Planter, double disk opnr w/fluted coulter, 15 inch row spacing	Soybean, mw 15 - 20 in rows	96
7/15/1	Sprayer, insecticide post emergence		93
8/15/1	Sprayer, insecticide post emergence		90
9/15/1	Sprayer, insecticide post emergence		86
11/15/1	Harvest, killing crop 20pct standing stubble		95

SOIL LOSS RESULTS:

T value: 3.0 t/ac/yr **Soil loss for cons. plan: 4.9 t/ac/yr**

FUEL USE EVALUATION:

Fuel type for entire run	*Fuel cost for entire simulation, US$/ac*
Diesel	31.0

Soil conditioning index (SCI)	*Avg. annual slope STIR*
0.38	9.19

The **SCI** is the **Soil Conditioning Index** rating. If the calculated index is a negative value, soil organic matter levels are predicted to decline under that production system. If the index is a positive value, soil organic matter levels are predicted to increase under that system.

The **STIR** value is the **Soil Tillage Intensity Rating**. It utilizes the speed, depth, surface disturbance percent and tillage type parameters to calculate a tillage intensity rating for the system used in growing a crop or a rotation. STIR ratings tend to show the differences in the degree of soil disturbance between systems. The kind, severity and number of ground disturbing passes are evaluated for the entire cropping rotation as shown in the management description.

KENTUCKY PHOSPORUS INDEX

Ky. phosphorus index: 54 (See phosphorus Index Worksheet)

Ky field vulnerability: Medium

Field Vulnerability for Phosphorus Loss	
Total Points From P Index	**Generalized Interpretations of P index**
< 30	**LOW** *potential for P movement from the field and low probability of an adverse impact to surface water.*
30-60	**MEDIUM** *potential for P movement from the field a moderate probability of an adverse impact to surface water.* When STP rates are less than 800 lbs/ac, these fields may be used to utilize animal waste following Nitrogen based plan only when applying conservation practices such as Crop Rotations, Contour farming, Residue and Tillage Management No-till, with grass waterways. Setbacks and/or Filter Strips are recommended.
61-112	**HIGH** *potential for P movement from the field and high probability of an adverse impact to surface water.* Strict setbacks and conservation practices must be applied. **If application of animal waste is planned, rates should not exceed phosphorus uptake of crop.**
>112	**VERY HIGH** *potential for P movement from the field and an adverse impact on surface water.* **Animal waste should not be applied.**

The Phosphorus index for this field/s is based upon the following **"Planned"** conditions.

- Mehlich 3 soil test P level:= 133 lb/ac
- Application Method =– Injection
- Application Timing =– April 1st through May 5th
- Application Setback from stream/creek/water body = Min of 75 feet
- Downstream Distance to stream/creek/water body = 75 to 100 ft
- Surface cover after application=: 70-75 %
- Watershed impaired due to ag. nutrients?:= No
- In Bluegrass County?:= No

From:	
Carlisle County Extension Office P.O. Box 518 Bardwell, Kentucky 42023	**UK COOPERATIVE EXTENSION SERVICE** University of Kentucky – College of Agriculture **Soil Test Report** Lexington 859-257-2785 Princeton 270-365-7541 www.rs.uky.edu/soils
COUNTY SAMPLE NO.: 0212 **REPORT FORM:** A	To: Rust, Kenneth 1305 CR 1234 Arlington, KY 42021 Carla Harper (270)-628-5458 *Agent for Agriculture / Natural Resources*

Date	Owner Sample ID	Owner ID	County Code	UK Lab NO.
9/22/2008	Tract 122	174	39	33601

Nutrient	Lab Results	Level of Adequacy (Very Low / Low / Medium / High / Very High)	Calculated CEC Data	
Phosphorus (P)	133	>>>		
Potassium (K)	309	>>>	CEC (meg/100g):	17
Soil pH	6.1		%Base Sat.:	71
Buffer pH	6.9		%K:	2
Calcium (Ca)	4044		%Ca:	52
Magnesium (Mg)	731	>>>	%Mg:	17
Zinc (Zn)	3.8		%H:	29
Other Test				

Acres	Primary Crop	Primary Management	Primary Use	Previous Crop	Previous Management	Previous Use	Crop 2 Years Ago Tobacco	Soil Drainage
	Corn	No Tillage	Grain	Soybeans	No Tillage	Grain		Moderate

RECOMMENDATIONS:	N	P2O5	K2O	LIME	Mg	Zn
	See AGR-1	None	None	see below	None	None

Paid: Yes

0.67 T/A of 100% effective lime is required. This can be supplied with 1.5 T/A from Anna Quarry (various) Illinois (44% RNV), OR 1 T/A from Anna Quarry (various, fine gradation) Illinois (65% RNV), OR 1 T/A from Martin Marietta Materials Inc/Fredonia Quarry (71% RNV), OR 1 T/A from Shawnee Stone Illinois (69% RNV)

COMMENTS:

Mehlich III used for P, K, Ca, Mg, and Zn (lbs/acre). Crop response is highly probable with Very Low or Low soil levels, slight with Medium, and not likely with High or Very High. N, P2O5, K2O, Mg, and Zn recommendations are based on lbs of the nutrient. Fertilizer needed will depend on nutrient conctent in the fertilizer. Soil pH and Sikora buffer pH are used for determining lime needs based on 100% effective lime. Lime quality in KY is defined by relative neutralizing value (RNV). RNVs for ag lime are determined by the KY Dept of Ag and are on the internet (publications at soils.rs.uky.edu). Lime is calculated based on quarries in your area.

For irrigated corn, increase N rate to 175 to 200 lbs N/acre due to higher yields and increased risk of losing N from leaching and dentrification.

Losing N from volatization with surface applied urea products can be significant with surface application after May. Affect of N loss can be minimized by (1) irrigating or incorporating within two days after application, (2) using a urease inhibitor, or (3) using the maximum N rate in the recommendation range.

If zinc is recommended, the recommended rate is for broadcast zinc applied as zinc sulfate. Banded zinc can be applied at 1/5 the broadcast rate. Zinc recommendations do not apply to the chelated form of zinc.

KENTUCKY PHOSPHORUS INDEX WORKSHEET

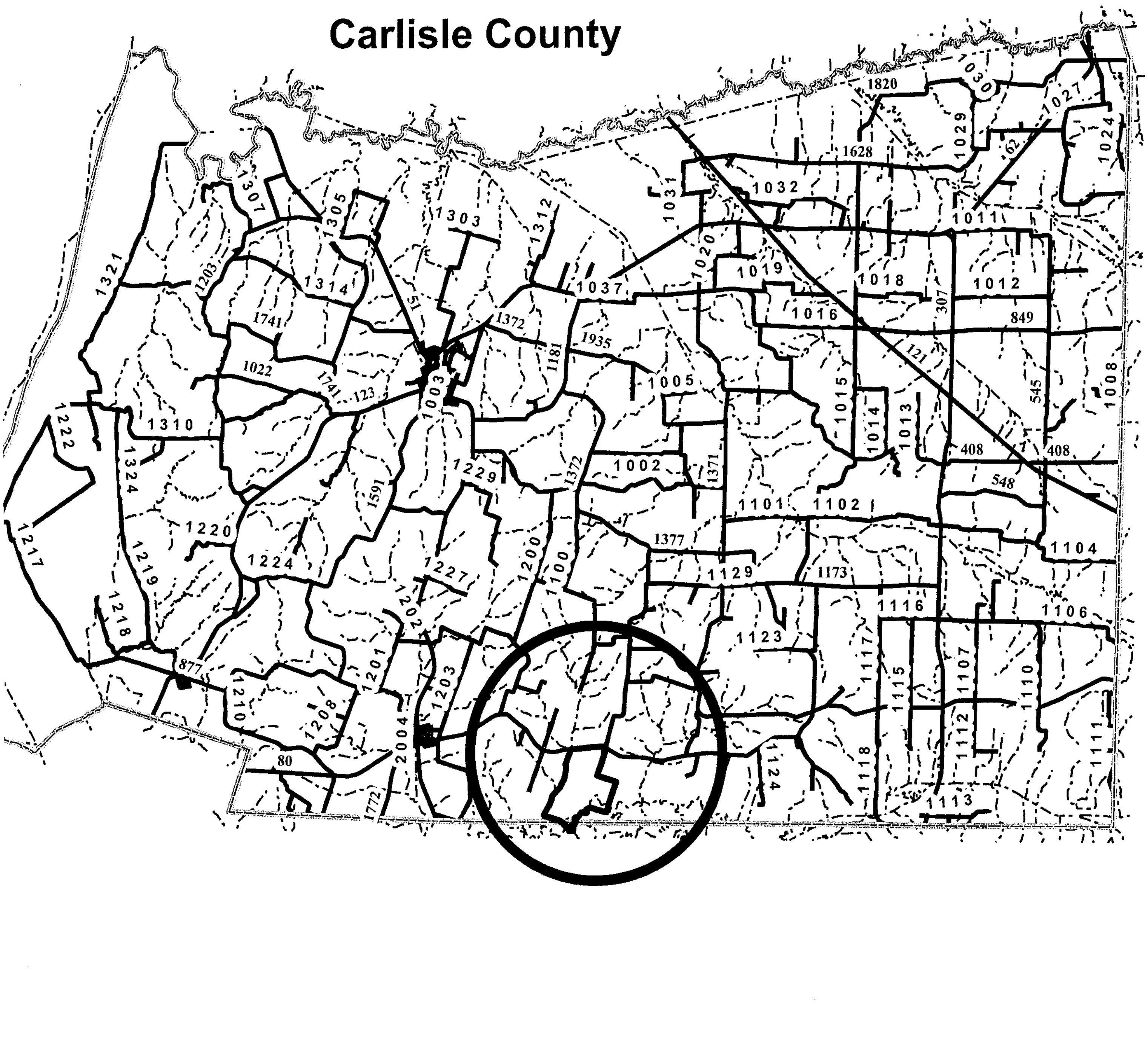
Farm:	0	Date:	October 1, 2008
Tract:	122	[redacted]	

[redacted]		FIELD FEATURE VALUE RATINGS (1,2,4, or 8 points)							
		Field #: 1 Acres: 64.1				Field #: ____ Acres: ____			
Field Features	**Weighted Factor (WF)**	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value
1. Hydrologic Soil Group	1	4	4	4	4				
2. Residual Soil Test (P)	3	1	3	1	3				
3. Field Slope Percent	1	4	4	4	4				
4. Land Cover Percent	3	4	12	1	3				
5. Vegetative Buffer Width	3	8	24	8	24				
6. Ag. Impaired Watershed	1	1	1	1	1				
7. Application Timing	3	2	6	2	6				
8. Application Method	3	8	24	1	3				
9. Distance To Waterbody	2	8	16	2	4				
10. MLRA Location	1	2	2	2	2				
FIELD FEATURES INDEX TOTALS	[redacted]	Existing Total*	**96**	**Planned Total**	**54**	Existing Total*	**0**	**Planned Total**	**0**

Note: If **existing total** results in a **"Low"** or **"Medium"** rating, a nitrogen, or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss	
Total Points from P Index	**Generalized Interpretation of P Index**
>30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

Carlisle County

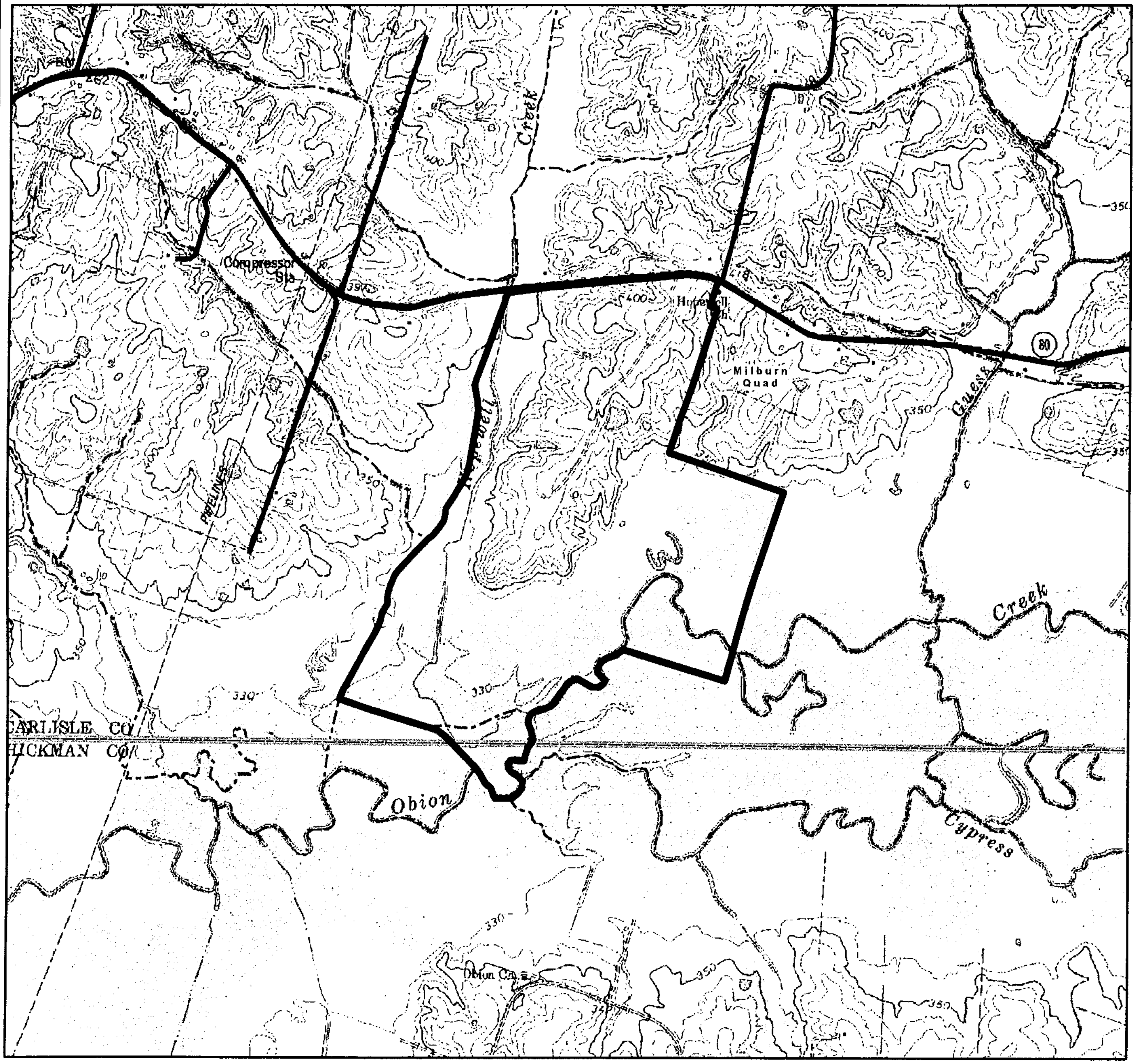


Topographic Map

Date: 4/29/2008

Customer(s): THOMAS R & DOROTHY LARKINS TRUST

Legal Description: T-488



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N

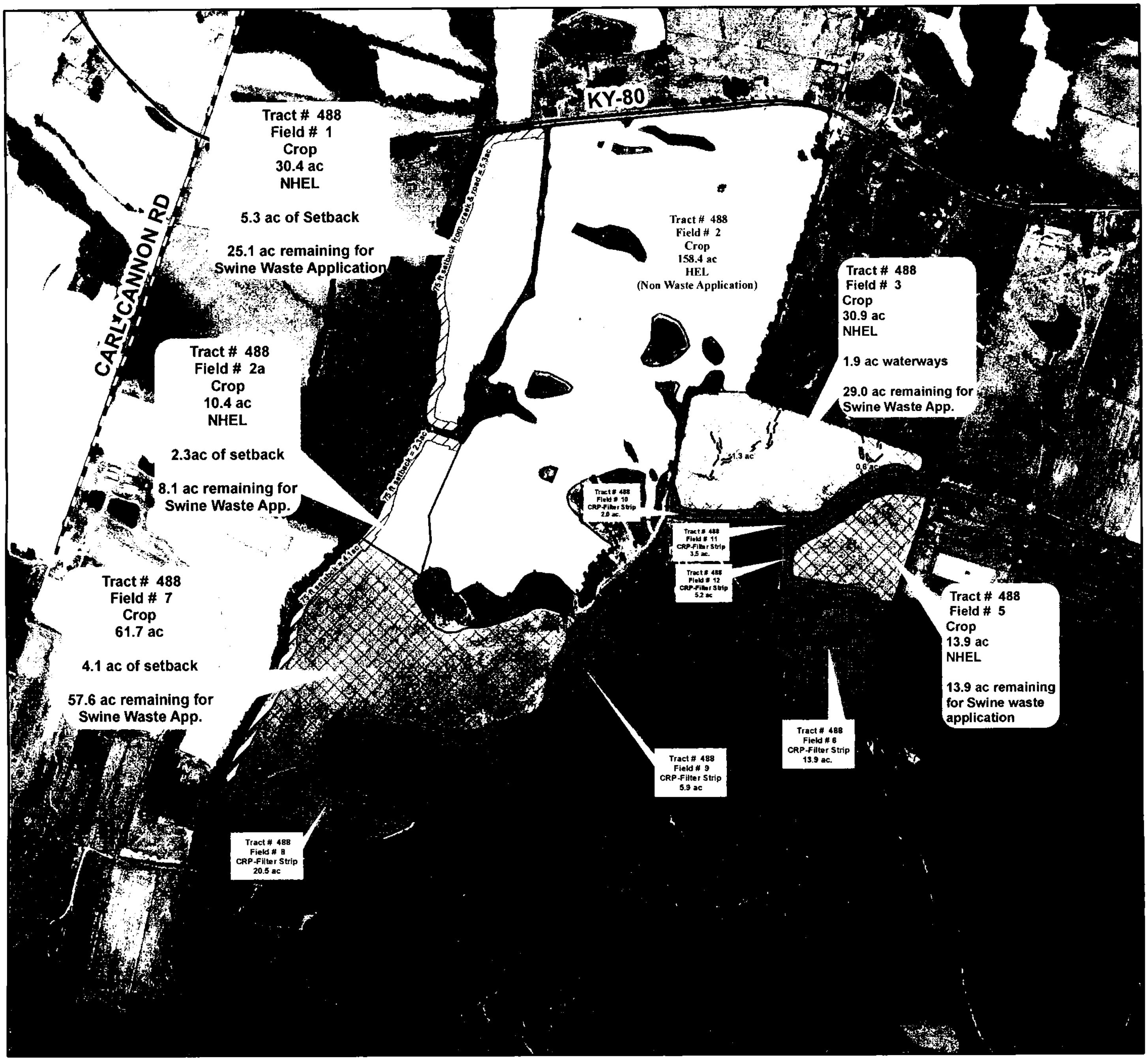
Conservation Plan Map

Date: 8/21/2008

Customer(s): THOMAS R & DOROTHY LARKINS TRUST
District: Carlisle & Hickman Co. Conservation Districts

Field Office: Bardwell NRCS Point of Delivery
Agency: USDA - NRCS
Assisted By: Templeton, Todd C

Legal Description: Hickman Co. Tract-488



Legend

- Consplan_T_488
- CNMP-WASTE APPLICATION
- 75 Ft Setback
- Concentrated Flow
- Waterway
- CRP
- US HWY
- EXPRESSWAY
- MAJOR ROAD
- Purchase_Local_Roads

1 inch equals 1,250 feet

700 0 700 1,400 2,100 2,800 Feet

N

Soil Map

Date: 10/1/2008

Customer(s): THOMAS R & DOROTHY LARKINS TRUST
District: BARDWELL SOIL & WATER CONSERVATION DISTRICT
Approximate Acres: 505.4
Legal Description: Tract-488

Field Office: BARDWELL PROGRAM DELIVERY POINT
Agency: USDA - NRCS

Legend

- Consplan_T_488
- US HWY
- EXPRESSWAY
- MAJOR ROAD
- Purchase_Local_Roads
- soilmu_a_ky039
- COUNTY LINES

610 0 610 1,220 1,830 2,440 Feet

N

Map Unit Description (Brief)

Carlisle and Hickman Counties, Kentucky

[Only those map units that have entries for the selected non-technical description categories are included in this report]

Map Unit: Ad - Adler silt loam, frequently flooded

Description Category: SOI

Loamy, nearly level bottom soil that is subject to flooding in winter and spring. Seasonal water table at about 2 feet.

Map Unit: CbA - Calloway silt loam, 0 to 2 percent slopes, rarely flooded

Description Category: SOI

Wet, silty, upland soil with a limited rooting zone and a compact pan at 18 to 30 inches. Moderate yield potential for most row crops.

Map Unit: Cn - Convent-Adler silt loams, frequently flooded

Description Category: SOI

Loamy, nearly level bottom soils that are subject to flooding mostly in winter and spring. Seasonal high water table from 12 to 24 inches.

Map Unit: Ct - Convent-Mhoon silt loams, frequently flooded

Description Category: SOI

Nearly level, wet bottom soils. Levee protected areas rarely flood. Unprotected areas flood for brief periods, in winter and spring. A seasonal high water table at depths of 18 inches, or more can be lowered by artificial drainage.

Map Unit: LoB - Loring silt loam, 2 to 6 percent slopes

Description Category: SOI

Upland soil that has a fragipan at a depth of about 2 feet that slows water movement and restricts roots. The soil has good workability, moderate yield potential, and is very highly erodible without ground cover.

Map Unit: LoB3 - Loring silt loam, 2 to 6 percent slopes, severely eroded

Description Category: SOI

Upland soil that has a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is mostly subsoil due to past erosion. Workability is fair and yield potential is low.

Map Unit: LoC3 - Loring silt loam, 6 to 12 percent slopes, severely eroded

Description Category: SOI

Upland soil with a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is mostly subsoil due to past erosion. Low yield potential. Best suited to pasture and hay.

Map Unit: LoD3 - Loring silt loam, 12 to 20 percent slopes, severely eroded

Description Category: SOI

Upland soil that has a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is nearly all subsoil due to past erosion. Yield potential is low. Best suited to pasture and hay.

From:
Carlisle County Extension Office
P.O. Box 518
Bardwell, Kentucky 42023

UK COOPERATIVE EXTENSION SERVICE
University of Kentucky – College of Agriculture

Soil Test Report

Lexington 859-257-2785
Princeton 270-365-7541
www.rs.uky.edu/soils

COUNTY SAMPLE NO.: 0213

REPORT FORM: A

To:
Rust, Kenneth
1305 CR 1234
Arlington, KY 42021

Carla Harper

Carla Harper (270)-628-5458
Agent for Agriculture / Natural Resources

Date	Owner Sample ID	Owner ID	County Code	UK Lab NO.
9/22/2008	Tract 488	174	39	33602

Nutrient	Lab Results	Level of Adequacy (Very Low / Low / Medium / High / Very High)
Phosphorus (P)	147	>>>
Potassium (K)	314	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
Soil pH	5.4	
Buffer pH	6.7	
Calcium (Ca)	2622	
Magnesium (Mg)	213	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
Zinc (Zn)	5.5	
Other Test		

Calculated CEC Data

CEC (meg/100g):	12
%Base Sat.:	57
%K:	3
%Ca:	47
%Mg:	7
%H:	43

Acres	Primary Crop	Primary Management	Primary Use	Previous Crop	Previous Management	Previous Use	Crop 2 Years Ago Tobacco	Soil Drainage
	Corn	No Tillage	Grain	Soybeans	No Tillage	Grain		Mod–Somewh

RECOMMENDATIONS:	N	P2O5	K2O	LIME	Mg	Zn
	See AGR-1	None	None	see below	None	None

Paid: Yes

1.33 T/A of 100% effective lime is required. This can be supplied with 3 T/A from Anna Quarry (various) Illinois (44% RNV), OR 2 T/A from Anna Quarry (various, fine gradation) Illinois (65% RNV), OR 2 T/A from Martin Marietta Materials Inc/Fredonia Quarry (71% RNV), OR 2 T/A from Shawnee Stone Illinois (69% RNV)

COMMENTS:

Mehlich III used for P, K, Ca, Mg, and Zn (lbs/acre). Crop response is highly probable with Very Low or Low soil levels, slight with Medium, and not likely with High or Very High. N, P2O5, K2O, Mg, and Zn recommendations are based on lbs of the nutrient. Fertilizer needed will depend on nutrient conctent in the fertilizer. Soil pH and Sikora buffer pH are used for determining lime needs based on 100% effective lime. Lime quality in KY is defined by relative neutralizing value (RNV). RNVs for ag lime are determined by the KY Dept of Ag and are on the internet (publications at soils.rs.uky.edu). Lime is calculated based on quarries in your area.

For irrigated corn, increase N rate to 175 to 200 lbs N/acre due to higher yields and increased risk of losing N from leaching and dentrification.

Losing N from volatization with surface applied urea products can be significant with surface application after May. Affect of N loss can be minimized by (1) irrigating or incorporating within two days after application, (2) using a urease inhibitor, or (3) using the maximum N rate in the recommendation range.

If zinc is recommended, the recommended rate is for broadcast zinc applied as zinc sulfate. Banded zinc can be applied at 1/5 the broadcast rate. Zinc recommendations do not apply to the chelated form of zinc.

KENTUCKY PHOSPHORUS INDEX WORKSHEET

Farm:	0	Date:	October 1, 2008
Tract:	488	[redacted]	

[redacted]		FIELD FEATURE VALUE RATINGS (1,2,4, or 8 points)							
		Field #: 1	Acres: 30.4			Field #: 2a	Acres: 10.4		
Field Features	**Weighted Factor (WF)**	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value
1. Hydrologic Soil Group	1	2	2	2	2	2	2	2	2
2. Residual Soil Test (P)	3	1	3	1	3	1	3	1	3
3. Field Slope Percent	1	1	1	1	1	1	1	1	1
4. Land Cover Percent	3	8	24	1	3	8	24	1	3
5. Vegetative Buffer Width	3	8	24	8	24	8	24	8	24
6. Ag. Impaired Watershed	1	1	1	1	1	1	1	1	1
7. Application Timing	3	2	6	2	6	2	6	2	6
8. Application Method	3	8	24	1	3	8	24	1	3
9. Distance To Waterbody	2	8	16	2	4	8	16	2	4
10. MLRA Location	1								
FIELD FEATURES INDEX TOTALS	[redacted]	Existing Total*	**101**	**Planned Total**	**47**	Existing Total*	**101**	**Planned Total**	**47**

Note: If **existing total** results in a **"Low"** or **"Medium"** rating, a nitrogen, or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss	
Total Points from P Index	**Generalized Interpretation of P Index**
>30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

KENTUCKY PHOSPHORUS INDEX WORKSHEET

Farm:	0	Date:	October 1, 2008
Tract:	488	[redacted]	

[redacted]		FIELD FEATURE VALUE RATINGS (1,2,4, or 8 points)							
		Field #: 3 Acres: 30.9				Field #: 5 Acres: 13.9			
Field Features	**Weighted Factor (WF)**	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value
1. Hydrologic Soil Group	1	4	4	4	4	2	2	4	4
2. Residual Soil Test (P)	3	1	3	1	3	1	3	1	3
3. Field Slope Percent	1	2	2	2	2	1	1	1	1
4. Land Cover Percent	3	8	24	1	3	8	24	1	3
5. Vegetative Buffer Width	3	8	24	1	3	8	24	1	3
6. Ag. Impaired Watershed	1	1	1	1	1	1	1	1	1
7. Application Timing	3	2	6	2	6	2	6	2	6
8. Application Method	3	8	24	1	3	8	24	1	3
9. Distance To Waterbody	2	8	16	8	16	8	16	8	16
10. MLRA Location	1								
FIELD FEATURES INDEX TOTALS	[redacted]	Existing Total*	**104**	**Planned Total**	**41**	Existing Total*	**101**	**Planned Total**	**40**

Note: If **existing total** results in a **"Low"** or **"Medium"** rating, a nitrogen, or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss

Total Points from P Index	**Generalized Interpretation of P Index**
>30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

KENTUCKY PHOSPHORUS INDEX WORKSHEET

Farm:	0	Date:	October 1, 2008
Tract:	488		

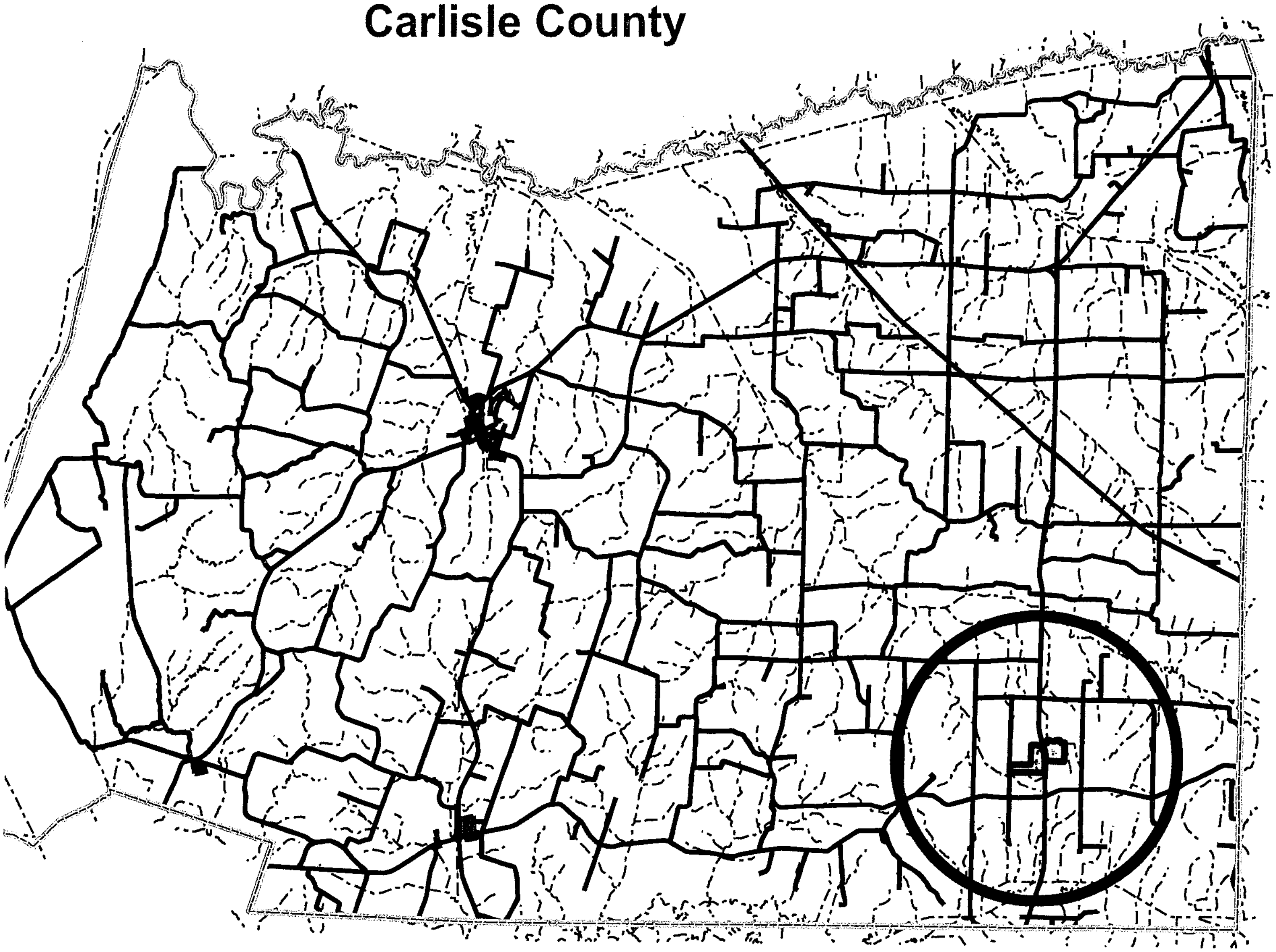
Field Features	Weighted Factor (WF)	FIELD FEATURE VALUE RATINGS (1,2,4, or 8 points)							
		Field #: 7	Acres: 57.6			Field #:	Acres:		
		Existing Value	WF x Existing Value	Planned Value	WF x Planned Value	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value
1. Hydrologic Soil Group	1	2	2	2	2				
2. Residual Soil Test (P)	3	1	3	1	3				
3. Field Slope Percent	1	1	1	1	1				
4. Land Cover Percent	3	8	24	1	3				
5. Vegetative Buffer Width	3	8	24	1	3				
6. Ag. Impaired Watershed	1	1	1	1	1				
7. Application Timing	3	2	6	2	6				
8. Application Method	3	8	24	1	3				
9. Distance To Waterbody	2	8	16	8	16				
10. MLRA Location	1								
FIELD FEATURES INDEX TOTALS		Existing Total*	**101**	**Planned Total**	**38**	Existing Total*	**0**	**Planned Total**	**0**

Note: If **existing total** results in a **"Low"** or **"Medium"** rating, a nitrogen, or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss

Total Points from P Index	Generalized Interpretation of P Index
>30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

Carlisle County

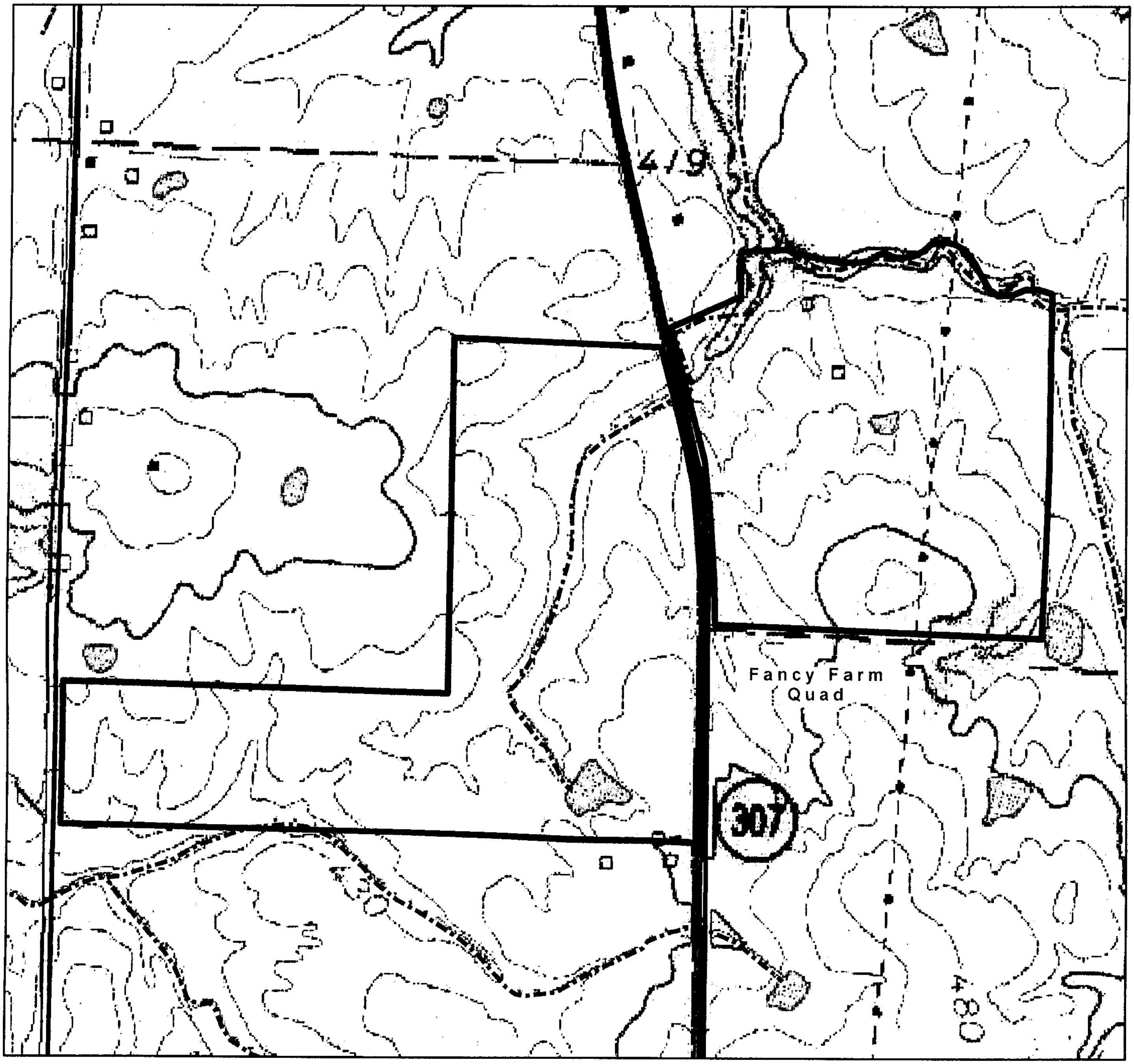


Topographic Map

Customer(s): THOMAS R & DOROTHY LARKINS TRUST

Approximate Acres: 0

Legal Description: T-830



1:7,416

N

Conservation Plan Map

Date: 8/28/2008

Landowner: THOMAS R & DOROTHY LARKINS TRUST

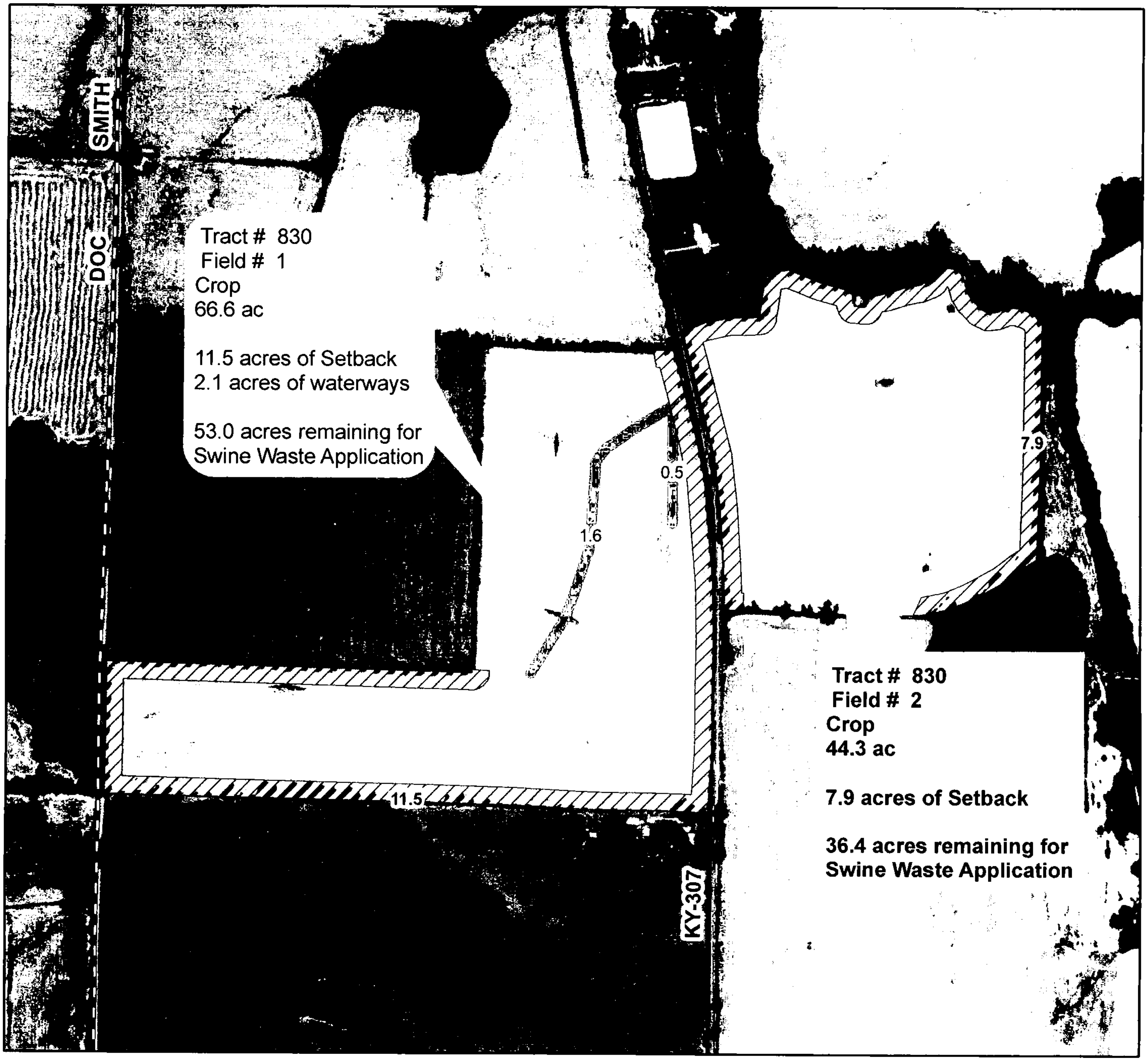
Swine Facility Operator: Kenneth Rust

Legal Description: Hickman Co. FSA Tract # 830

Field Office: BARDWELL PROGRAM DELIVERY POINT

Agency: USDA-NRCS

Assisted By: Templeton, Todd C



Legend

- 75 Ft Setback
- Grass Waterways
- Creek/Stream
- Concentrated Flow
- Consplan_T_830
- US HWY
- EXPRESSWAY
- MAJOR ROAD
- Purchase_Local_Roads
- COUNTY LINES

1 inch equals 660 feet

350 0 350 700 1,050 1,400 Feet

N

SOIL MAP

Customer(s): THOMAS R & DOROTHY LARKINS TRUST

Approximate Acres: 0

Legal Description: T-830

1:7,702

N

Map Unit Description (Brief)

Carlisle and Hickman Counties, Kentucky

[Only those map units that have entries for the selected non-technical description categories are included in this report]

Map Unit: Ad - Adler silt loam, frequently flooded

Description Category: SOI

Loamy, nearly level bottom soil that is subject to flooding in winter and spring. Seasonal water table at about 2 feet.

Map Unit: LoB - Loring silt loam, 2 to 6 percent slopes

Description Category: SOI

Upland soil that has a fragipan at a depth of about 2 feet that slows water movement and restricts roots. The soil has good workability, moderate yield potential, and is very highly erodible without ground cover.

Map Unit: LoC3 - Loring silt loam, 6 to 12 percent slopes, severely eroded

Description Category: SOI

Upland soil with a fragipan at a depth of about 1 foot that slows water movement and restricts roots. The plow layer is mostly subsoil due to past erosion. Low yield potential. Best suited to pasture and hay.

USDA NRCS Natural Resources Conservation Service

2009 CTA General

Carlisle County NRCS Field Office

RUSLE2 Field(s) Record

Landuser: Kenneth Rust   Carlisle County Tract No. 830   Field 1 & 2 = 89.4 acres

Inputs:

Location: Kentucky\Carlisle & Hickman County
Soil: LoC3 Loring silt loam, 6 to 12 percent slopes, severely eroded\Loring silt loam 85%
Slope length (horiz): 150 ft   Avg. slope steepness: 8.0 %

Base management: c.Other Local Mgt Records\MT Corn w/injected swine manure + NT Wheat + NT DC Beans

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
4/7/0	Manure injector, liquid low disturb.30 inch		85
4/14/0	Harrow, rotary, light, fluff fragile residue		77
4/15/0	Sprayer, pre-emergence		75
4/15/0	Planter, double disk opnr w/fluted coulter	Corn, grain	75
5/15/0	Sprayer, insecticide post emergence		66
9/22/0	Harvest, killing crop 20pct standing stubble		93
10/10/0	Sprayer, kill crop		91
10/15/0	Drill or air seeder single disk openers 7-10 in spac.	Wheat, winter south 7in rows	91
3/1/1	Fert applic. surface broadcast		80
3/15/1	Sprayer, insecticide post emergence		79
5/7/1	Sprayer, insecticide post emergence		66
6/20/1	Harvest, killing crop 20pct standing stubble		96
6/23/1	Sprayer, kill crop		96
6/23/1	Planter, double disk opnr w/fluted coulter, 15 inch row spacing	Soybean, mw 15 - 20 in rows	96
7/15/1	Sprayer, insecticide post emergence		93
8/15/1	Sprayer, insecticide post emergence		90
9/15/1	Sprayer, insecticide post emergence		86
11/15/1	Harvest, killing crop 20pct standing stubble		95

SOIL LOSS RESULTS:

T value: 3.0 t/ac/yr   **Soil loss for cons. plan: 4.9 t/ac/yr**

FUEL USE EVALUATION:

Fuel type for entire run	*Fuel cost for entire simulation, US$/ac*
Diesel	31.0

Soil conditioning index (SCI)	*Avg. annual slope STIR*
0.38	9.19

The **SCI** is the **Soil Conditioning Index** rating. If the calculated index is a negative value, soil organic matter levels are predicted to decline under that production system. If the index is a positive value, soil organic matter levels are predicted to increase under that system.

The **STIR** value is the **Soil Tillage Intensity Rating**. It utilizes the speed, depth, surface disturbance percent and tillage type parameters to calculate a tillage intensity rating for the system used in growing a crop or a rotation. STIR ratings tend to show the differences in the degree of soil disturbance between systems. The kind, severity and number of ground disturbing passes are evaluated for the entire cropping rotation as shown in the management description.

KENTUCKY PHOSPORUS INDEX

Ky. phosphorus index: 52 to 54 (See phosphorus Index Worksheet)

Ky field vulnerability: Medium

Field Vulnerability for Phosphorus Loss	
Total Points From P Index	**Generalized Interpretations of P index**
< 30	**LOW** *potential for P movement from the field and low probability of an adverse impact to surface water.*
30-60	**MEDIUM** *potential for P movement from the field a moderate probability of an adverse impact to surface water.* When STP rates are less than 800 lbs/ac, these fields may be used to utilize animal waste following Nitrogen based plan only when applying conservation practices such as Crop Rotations, Contour farming, Residue and Tillage Management No-till, with grass waterways. Setbacks and/or Filter Strips are recommended.
61-112	**HIGH** *potential for P movement from the field and high probability of an adverse impact to surface water.* Strict setbacks and conservation practices must be applied. **If application of animal waste is planned, rates should not exceed phosphorus uptake of crop.**
>112	**VERY HIGH** *potential for P movement from the field and an adverse impact on surface water.* **Animal waste should not be applied.**

The Phosphorus index for this field/s is based upon the following **"Planned"** conditions.

- Mehlich 3 soil test P level:= 52 lb/ac
- Application Method =– Injection
- Application Timing =– April 1st through May 5th
- Application Setback from stream/creek/water body = Min of 75 feet
- Downstream Distance to stream/creek/water body = 75 to 100 ft
- Surface cover after application=: 70-75 %
- Watershed impaired due to ag. nutrients?:= No
- In Bluegrass County?:= No

From:
Carlisle County Extension Office
P.O. Box 518
Bardwell, Kentucky 42023

UK COOPERATIVE EXTENSION SERVICE
University of Kentucky – College of Agriculture

Soil Test Report

Lexington 859-257-2785
Princeton 270-365-7541
www.rs.uky.edu/soils

COUNTY SAMPLE NO.: 0214

REPORT FORM: A

To:
Rust, Kenneth
1305 CR 1234
Arlington, KY 42021

Carla Harper
Carla Harper (270)-628-5458
Agent for Agriculture / Natural Resources

Date	Owner Sample ID	Owner ID	County Code	UK Lab NO.
9/22/2008	tract 830	174	39	33603

Nutrient	Lab Results	Level of Adequacy (Very Low / Low / Medium / High / Very High)
Phosphorus (P)	52	>>>>>>>>>>>>>>>>>>>>>>>>>>>>
Potassium (K)	304	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
Soil pH	6.7	
Buffer pH	7.1	
Calcium (Ca)	3386	
Magnesium (Mg)	351	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
Zinc (Zn)	2.4	
Other Test		

Calculated CEC Data	
CEC (meg/100g):	13
%Base Sat.:	70
%K:	3
%Ca:	57
%Mg:	10
%H:	30

Acres	Primary Crop	Primary Management	Primary Use	Previous Crop	Previous Management	Previous Use	Crop 2 Years Ago Tobacco	Soil Drainage
	Soybeans	No Tillage	Grain	Corn	No Tillage	Grain		Moderate

RECOMMENDATIONS:	N	P2O5	K2O	LIME	Mg	Zn
	See AGR-1	See AGR-1	None	None	None	None

Paid: Yes

COMMENTS:

Mehlich III used for P, K, Ca, Mg, and Zn (lbs/acre). Crop response is highly probable with Very Low or Low soil levels, slight with Medium, and not likely with High or Very High. N, P2O5, K2O, Mg, and Zn recommendations are based on lbs of the nutrient. Fertilizer needed will depend on nutrient content in the fertilizer. Soil pH and Sikora buffer pH are used for determining lime needs based on 100% effective lime. Lime quality in KY is defined by relative neutralizing value (RNV). RNV values for ag lime are determined by the KY Dept of Ag and are on the internet (publications at soils.rs.uky.edu).

No nitrogen is recommended for well-nodulated soybeans.

Inoculate seed planted where soybeans have not been grown in the past 3 to 5 years, or where soybeans had few nodules.

If the pH is below 6.2 at seeding time apply 1 to 2 ounces of sodium molybdate (0.4 to 0.8 ounces of elemental molybdenum) per acre as a seed treatment. If both inoculum and molybdenum are needed, apply inoculum to the seed and broadcast (spray) 1 lb. Sodium molybdate (6.4 oz molybdenum) ahead of final seedbed preparation. Not more that 2 lb sodium molybdate (13 oz molybdenum) per acre should be used during any 5-year period.

KENTUCKY PHOSPHORUS INDEX WORKSHEET

Farm:	0	Date:	October 1, 2008
Tract:	830	[redacted]	

[redacted]		FIELD FEATURE VALUE RATINGS (1,2,4, or 8 points)							
		Field #: 1 Acres: 66.6				Field #: 2 Acres: 44.3			
Field Features	**Weighted Factor (WF)**	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value	Existing Value	WF x Existing Value	Planned Value	WF x Planned Value
1. Hydrologic Soil Group	1	4	4	4	4	4	4	4	4
2. Residual Soil Test (P)	3	1	3	1	3	1	3	1	3
3. Field Slope Percent	1	4	4	4	4	4	4	4	4
4. Land Cover Percent	3	4	12	1	3	4	12	1	3
5. Vegetative Buffer Width	3	8	24	8	24	8	24	8	24
6. Ag. Impaired Watershed	1	1	1	1	1	1	1	1	1
7. Application Timing	3	2	6	2	6	2	6	2	6
8. Application Method	3	8	24	1	3	8	24	1	3
9. Distance To Waterbody	2	1	2	1	2	4	8	2	4
10. MLRA Location	1	2	2	2	2	2	2	2	2
FIELD FEATURES INDEX TOTALS	[redacted]	Existing Total*	**82**	**Planned Total**	**52**	Existing Total*	**88**	**Planned Total**	**54**

Note: If **existing total** results in a **"Low"** or **"Medium"** rating, a nitrogen, or phosphorus based nutrient management plan may be implemented.

Field Vulnerability for Phosphorus Loss

Total Points from P Index	**Generalized Interpretation of P Index**
>30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

NRCS
Natural Resources Conservation Service
BARDWELL PROGRAM DELIVERY POINT
140 STATE ROUTE 123
BARDWELL, KY 42023-8734
(270) 628-5453

MARK CLAXTON
DISTRICT CONSERVATIONIST

Conservation Plan

Swine Facility Site Owner/Operator

KENNETH D RUST
1305 COUNTY ROAD 1234
ARLINGTON, KY 42021

Landowner of Waste Applicatio

Thomas R. & Dorothy Larkins Trust
40 West Clay Street
Clinton, KY 42031

OBJECTIVE(S)

This Conservation plan is a required componet of the Comprehensive Nutrient Management Plan (CNMP) Developed by Kenneth Rust to as a KYDOW permit requirement to construct and operate two Tosh Farms Swine Feeding Facility.

Tosh Farms Swine Feeding Facility

Tract: 433

Comprehensive Nutrient Management Plan: (100)

A Comprehensive Nutrient Management Plan (CNMP) has been developed according to KY FOTG Standard 590 that addresses the temporary storage and nutrient utilization of animal waste generated by an Animal Feeding Operation (AFO).

Field	Planned Amount	Month	Year	Applied Amount	Date
1a	1 no	10	2008		
Total:	1 no				

Waste Storage Facility: (313) Non-Reportable in PRS

Swine waste will be collected and temporarily stored in concrete Holding pits located beneath slated feeding floors. Concrete pits will be constructed according to attached Kentucky Licensed Professional Engineer's stamped and DOW approved design and specifications. Swine waste will be utilized according to attached Comprehensive nutrient managment plan.

Field	Planned Amount	Month	Year	Applied Amount	Date
1a	2 no	12	2008		
Total:	2 no				

Cropland

Tract: 97

Conservation Crop Rotation

Continuous rotation of Mulch-till Corn with injected swine manure followed by No-till Wheat and No-till double crop Soybeans.

See enclosed Revised Univeral Soil Loss Equation (RUSLE2) record for the Soil Condition Index (SCI) evaluation of this crop rotation in combination with the supporting residue and tillage management systems.

Field	Planned Amount	Month	Year	Applied Amount	Date
5	41.1 ac	4	2110-2013		
6	28.5 ac	4	2110-2013		
8	242.7 ac	4	2110-2013		
9	81.1 ac	4	2110-2013		
10	76.5 ac	4	2110-2013		
Total:	469.9 ac		2110-2013		

Nutrient Management

Crop nutrient needs will be obtained from application of Animal waste according to comprehensive nutrient management plan.

Field	Planned Amount	Month	Year	Applied Amount	Date
5	41.1 ac	4	2110-2013		
6	28.5 ac	4	2110-2013		
8	242.7 ac	4	2110-2013		
9	81.1 ac	4	2110-2013		
10	76.5 ac	4	2110-2013		
Total:	469.9 ac		2110-2013		

Residue and Tillage Management, Mulch Till

Following spring injection of swine waste, a phillips harrow will be lightly run over field to smooth out application ruts and Corn will be planted using residue and tillage management, mulch-till (345).

Seedbed for corn will be prepared by lightly running a full width tillage implements such as phillips harrow or field cultivator. See the Revised Universal Soil Loss Equation (RUSLE2) erosion record(s) for the tillage operations necessary to obtain residue amounts needed to meet plan soil loss objectives.

Field	Planned Amount	Month	Year	Applied Amount	Date
5	41.1 ac	4	2110-2013		
6	28.5 ac	4	2110-2013		
8	242.7 ac	4	2110-2013		
9	81.1 ac	4	2110-2013		
10	76.5 ac	4	2110-2013		
Total:	469.9 ac		2110-2013		

Residue and Tillage Management, No-Till/Strip Till/Direct Seed

Wheat and Soybeans will be planted using residue and tillage management, no-till (329).

Crop residue will be uniformly distributed and soil left undisturbed from harvest to spring planting (except for nutrient injection). Planting will be accomplished in a narrow seedbed or slot created by coulters, row cleaners or disk openers. Weed control will be accomplished by herbicide applications. See enclosed Revised Universal Soil Loss Equation (RUSLE2) erosion calculation record for estimates of residue amounts needed to meet planned soil loss objectives.

Field	Planned Amount	Month	Year	Applied Amount	Date
5	41.1 ac	10	2010-2013		
6	28.5 ac	10	2010-2013		
8	242.7 ac	10	2010-2013		
9	81.1 ac	10	2010-2013		
10	76.5 ac	10	2010-2013		
Total:	469.9 ac		2010-2013		

Tract: 122

Conservation Crop Rotation

Continuous rotation of Mulch-till Corn with injected swine manure followed by No-till Wheat and No-till double crop Soybeans.

See enclosed Revised Univeral Soil Loss Equation (RUSLE2) record for the Soil Condition Index (SCI) evaluation of this crop rotation in combination with the supporting residue and tillage management systems.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	64.1 ac	4	2010-2013		
Total:	64.1 ac				

Nutrient Management

Crop nutrient needs will be obtained from application of Animal waste according to comprehensive nutrient management plan.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	64.1 ac	4	2010-2013		
Total:	64.1 ac				

Residue and Tillage Management, Mulch Till

Following spring injection of swine waste, a phillips harrow will be lightly run over field to smooth out application ruts and Corn will be planted using residue and tillage management, mulch-till (345).

Seedbed for corn will be prepared by lightly running a full width tillage implements such as phillips harrow or field cultivator. See the Revised Universal Soil Loss Equation (RUSLE2) erosion record(s) for the tillage operations necessary to obtain residue amounts needed to meet plan soil loss objectives.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	64.1 ac	4	2010-2013		
Total:	64.1 ac				

Residue and Tillage Management, No-Till/Strip Till/Direct Seed

Wheat and Soybeans will be planted using residue and tillage management, no-till (329).

Crop residue will be uniformly distributed and soil left undisturbed from harvest to spring planting (except for nutrient injection). Planting will be accomplished in a narrow seedbed or slot created by coulters, row cleaners or disk openers. Weed control will be accomplished by herbicide applications. See enclosed Revised Universal Soil Loss Equation (RUSLE2) erosion calculation record for estimates of residue amounts needed to meet planned soil loss objectives.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	64.1 ac	10	2010-2013		
Total:	64.1 ac				

Tract: 488

Conservation Crop Rotation

Continuous rotation of Corn with injected swine waste and Full Season Soybeans.

See enclosed Revised Universal Soil Loss Equation (RUSLE2) erosion record for the Soil Condition Index (SCI) evaluation of this planned crop rotation in combination with the supporting planned residue and tillage management system.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	30.4 ac	4	2010-2013		
2a	10.4 ac	4	2010-2013		
3	30.9 ac	4	2010-2013		
5	13.9 ac	4	2010-2013		
7	61.7 ac	4	2010-2013		
Total:	147.3 ac		2010-2013		

Nutrient Management

Crop nutrient needs will be obtained from application of Animal waste according to comprehensive nutrient management plan.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	30.4 ac	4	2010-2013		
2a	10.4 ac	4	2010-2013		
3	30.9 ac	4	2010-2013		
5	13.9 ac	4	2010-2013		
7	61.7 ac	4	2010-2013		
Total:	147.3 ac		2010-2013		

Residue and Tillage Management, Mulch Till

Corn and Soybeans will be planted using residue and tillage management, mulch-till (345).
Crop residues will be uniformly spread on soil surface after harvest. The soil will be tilled prior to planting using full width tillage implements such as chisels, rippers, light disking, field cultivators and/or phillips harrows. Weed control will be accomplished by a combination of tillage and herbicide applications. See the enclosed Revised Universal Soil Loss Equation (RUSLE2) record(s)for the tillage operations and residue amounts necessary to meet the planned soil loss objectives.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	30.4 ac	4	2010-2013		
2a	10.4 ac	4	2010-2013		
3	30.9 ac	4	2010-2013		
5	13.9 ac	4	2010-2013		
7	61.7 ac	4	2010-2013		
Total:	147.3 ac		2010-2013		

Tract: 830

Conservation Crop Rotation

Continuous rotation of Mulch-till Corn with injected swine manure followed by No-till Wheat and No-till double crop Soybeans.

See enclosed Revised Univeral Soil Loss Equation (RUSLE2) record for the Soil Condition Index (SCI) evaluation of this crop rotation in combination with the supporting residue and tillage management systems.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	66.6 ac	4	2010-2013		
2	44.3 ac	4	2010-2013		
Total:	110.9 ac		2010-2013		

Nutrient Management

Crop nutrient needs will be obtained from application of Animal waste according to comprehensive nutrient management plan.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	66.6 ac	4	2010-2013		
2	44.3 ac	4	2010-2013		
Total:	110.9 ac		2010-2013		

Residue and Tillage Management, Mulch Till

Following spring injection of swine waste, a phillips harrow will be lightly run over field to smooth out application ruts and Corn will be planted using residue and tillage management, mulch-till (345).

Seedbed for corn will be prepared by lightly running a full width tillage implements such as phillips harrow or field cultivator. See the Revised Universal Soil Loss Equation (RUSLE2) erosion record(s) for the tillage operations necessary to obtain residue amounts needed to meet plan soil loss objectives.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	66.6 ac	4	2010-2013		
2	44.3 ac	4	2010-2013		
Total:	110.9 ac		2010-2013		

Residue and Tillage Management, No-Till/Strip Till/Direct Seed

Wheat and Soybeans will be planted using residue and tillage management, no-till (329).

Crop residue will be uniformly distributed and soil left undisturbed from harvest to spring planting (except for nutrient injection). Planting will be accomplished in a narrow seedbed or slot created by coulters, row cleaners or disk openers. Weed control will be accomplished by herbicide applications. See enclosed Revised Universal Soil Loss Equation (RUSLE2) erosion calculation record for estimates of residue amounts needed to meet planned soil loss objectives.

Field	Planned Amount	Month	Year	Applied Amount	Date
1	66.6 ac	10	2010-2013		
2	44.3 ac	10	2010-2013		
Total:	110.9 ac		2010-2013		

CERTIFICATION OF PARTICIPANTS

Swine Facility Owner/Operator

Kenneth D Rust 10-3-08

KENNETH D RUST DATE

Landowner of Land Application of Waste

Mike Larkins 10-3-08

Authorized Signature Authority Date

for Thomas R. & Dorothy Larkins Trust

CERTIFICATION OF:

USDA- NRCS

Mark T Clayton 10/30/08

District Conservationist DATE

Local Plan Review

Carlisle County Conservation District (Co. of Swine Facility) Date

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Natural Resources Conservation Service
CLINTON SERVICE CENTER
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CHARLIE B. MCINTIRE
DISTRICT CONSERVATIONIST

Conservation Plan

THOMAS R & DOROTHY LARKINS TRUST
404 W CLAY ST
CLINTON, KY 42031

CRP cp21

Tract: 488

Filter Strip: (393)

(CP-21) Strips or areas of permanent vegetation established and/or maintained for removing sediment, organic matter and other pollutants from runoff through CRP.

Field	Planned Amount	Month	Year	Applied Amount	Date
6	13.9 ac	8	1999	13.9 ac	8/31/1999
8	20.5 ac	8	1999	20.5 ac	8/31/1999
9	5.9 ac	8	1999	5.9 ac	8/31/1999
10	2 ac	8	1999	2 ac	8/31/1999
11	3.5 ac	8	1999	3.5 ac	8/31/1999
12	5.2 ac	8	1999	5.2 ac	8/31/1999
Total:	51 ac			51 ac	

Upland Wildlife Habitat Management: (645)

Conservation Cover will be managed according to CRP Management and maintenance guidelines to provide wildlife habitat and maintain practice for duration of practice life span.

Field	Planned Amount	Month	Year	Applied Amount	Date
6	13.9 ac	8	1999	13.9 ac	8/31/1999
8	20.5 ac	8	1999	20.5 ac	8/31/1999
9	5.9 ac	8	1999	5.9 ac	8/31/1999
10	2 ac	8	1999	2 ac	8/31/1999
11	3.5 ac	8	1999	3.5 ac	8/31/1999
12	5.2 ac	8	1999	5.2 ac	8/31/1999
Total:	51 ac			51 ac	

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN (CNMP)

FOR

Kenneth Rust

September 2008

APPENDIX D

- NRCS Conservation Practice Standard Nutrient Management, code 590.
- Nutrient Management in Kentucky, University of Kentucky cooperative Extension Service publication, IP-71.
- Taking Soil Test Samples, University of Kentucky cooperative Extension Service publication, AGR-16.
- Sampling Animal Manure, University of Kentucky cooperative Extension Service publication, ID-148.
- Lime and Nutrient Recommendations, University of Kentucky cooperative Extension Service publication, AGR-1

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Acre)

CODE 590

DEFINITION

Managing the amount, sources, placement, form and timing of the application of nutrients and soil amendments.

PURPOSES

- To budget and supply nutrients for plant production.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To minimize agricultural nonpoint source pollution of surface and ground water resources.
- To maintain or improve the physical, chemical and biological condition of soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied.

CRITERIA

General Criteria Applicable to All Purposes

Plans for nutrient management shall comply with all applicable Federal, state, and local laws and regulations.

Plans for nutrient management shall be developed in accordance with policy requirements of the NRCS General Manual Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities) and Title 190, Part 402 (Ecological Sciences, Nutrient Management, Policy); technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH), and the NRCS National Agronomy Manual (NAM) Section 503.

Employees of NRCS and other persons who approve plans for nutrient management shall be certified through a certification program acceptable to NRCS in the state of Kentucky. Persons who develop (but not approve) nutrient management plans are not required to become certified. Note: Certification may be required for persons who develop nutrient management plans when regulatory permits or other special rules require technical assistance from a certified nutrient management specialist.

Plans for nutrient management that are elements of a more comprehensive conservation plan or waste management system shall recognize other requirements of the respective plan and be compatible with the other plan requirements.

A nutrient budget for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to animal manure and organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water. Note: As crops, method of application, feed ration or consistency of the manure change, it will be necessary to re-calculate an appropriate nutrient application rate using a nutrient budget.

Realistic yield goals shall be established based on soil productivity information, historical yield data, climatic conditions, level of management and/or local research on similar soil, cropping systems, and soil and manure/organic by-products tests. For new crops or varieties, industry yield recommendations may be used until documented yield information is available.

Individual nutrient recommendations will be formulated on a philosophy that considers University of Kentucky Lime and Fertilizer recommendations or crop nutrient removal potential. ***Estimated crop nutrient removal values (nutrients removed in harvested plant biomass) approved by NRCS for several key crops grown in Kentucky can be referenced in Appendix A, Table 6 of this standard.***

Excess nutrients shall not be applied in situations in which it causes unacceptable nutrient imbalances in crops or forages.

Nitrogen (N), Phosphorus (P) and Potassium (K) - The planned rates of nutrient application, as documented in the nutrient budget, shall match the recommended rates as closely as possible for all nutrients including nitrogen, phosphorus and potassium. More information about nutrient availability from certain sources, storage/application losses, and removal values can be referenced in ***Appendix A, Tables 1-6 of this standard.***

Note: The following information applies to all applied nutrients such as from commercial (mineral based) fertilizers, animal wastes and other sources:

<u>When the soil test results indicate a level of phosphorus that is 400 lbs/acre or less,</u> the University of Kentucky Lime and Fertilizer recommendations or NRCS approved estimated crop removal values will be used to determine application rates based on nitrogen as the limiting nutrient.

When the plan is being implemented on a nitrogen basis, manure or other organic by-products shall be applied at rates that are limited by the amount of nitrogen in the material. Credit for available nitrogen provided from cover crops and previous crop residues shall be considered in the nutrient budget. Refer to ***Appendix A, Table 4 (Estimated Nitrogen Availability To Succeeding Crops From Legumes)*** for related information.

In certain cropping situations such as involving soybeans, alfalfa and other legumes, nitrogen application may not be recommended according to the University of Kentucky Lime and Fertilizer recommendations. In these situations, manure or other organic by-products (containing nitrogen) may be applied at rates not to exceed the estimated removal of nitrogen in harvested plant biomass.

Estimated crop nutrient removal values approved by NRCS are referenced in Appendix A, Table 6

<u>When the soil test results indicate a level of phosphorus above 400 lbs/acre,</u> *nutrient* application rates will be determined by using one of the following options: Phosphorus Threshold (PT) or Phosphorus Index (PI).

Option 1 - Soil Test Phosphorus Threshold (PT) Values. In situations where the soil test phosphorus (STP) levels are below 400 lbs/acre, nitrogen based nutrient applications may be applied. As soil test levels increase above 400 lbs/acre, planned phosphorus application rates (from any nutrient source) shall be determined as based on estimated phosphorus removal in harvested plant biomass at levels prescribed in the phosphorus threshold. When soil test phosphorus exceeds 1066 lbs/acre no further applications of phosphorus (from any nutrient source) shall be made to the field/area.

When the Phosphorus Threshold option is utilized, the following information applies:

401-800 STP - Phosphorus applications at rates not to exceed the estimated removal of phosphorus in the harvested plant biomass.

801-1066 STP - Phosphorus applications at rates not to exceed 1/2 of the estimated removal of phosphorus in the harvested plant biomass.

(Reference the ***Phosphorus Threshold for Kentucky in Appendix C (P Matrix,Option 1) of this standard*** for more information.)

Option 2 - Phosphorus Index (PI) Rating.

Low or Medium Risk Sites - Nitrogen based nutrient application.

High and Very High Risk Sites - Phosphorus based or no nutrient application.

- In some instances the (PI) rating may be in the low or medium risk category when soil test phosphorus is above 400 lbs/acre. In these instances, nutrient application rates based on nitrogen may be planned. University of Kentucky Lime and Fertilizer feet from streams, sinkholes and other sensitive areas is recommended. Additional federal, state and local guidelines may apply to application setbacks.

- Liquid (animal manure) waste applications shall not be applied on frozen soils. Liquid applications may be land applied in fields/areas within 30 days of the beginning of crop growth when soil conditions are favorable unless heavy precipitation is forecasted before the liquid can be absorbed into the soil profile.
- These exceptions will only apply if Best Management Practices (BMP's) are applied such as filter strips, crop residue management, vegetative cover management, application set backs and other strategies are implemented properly so as to reduce the risk of pollution.

Nutrient Application Methods

Nutrient applications associated with irrigation systems shall be applied in accordance with the requirements of Irrigation Water Management (Code 449).

Additional Criteria Applicable to Manure or Organic By-Products Applied as a Plant Nutrient Source

Animal manure applications are primarily based on plant available nutrient content. However, the volume applied (tons, gallons, cubic feet, acre-inches) on a per acre basis during each application event and the soil conditions at the time of application are also of concern. For these reasons a sound nutrient management plan must contain strategies for application that consider manure nutrient values, volume applied during each application and other site specific limitations.

Nutrient Analysis/Testing

Nutrient values of manure and organic by-products (excluding sewage and bio-solids) shall be determined (by laboratory analysis) prior to land application.

Exception: When preparing nutrient management plans on "new" animal feeding operations, (those without manure in storage), approved "book values" for estimated manure nutrient content may be used as a basis for planning application rates until a manure analysis can be obtained. Approved "book values" are those recognized by the NRCS and the University. ***Approved book values for animal manures recognized by NRCS and the University can be referenced in Appendix A, Tables 1,2,3,5 of this standard.***

When an analysis of the manure is available, an application amount can be determined using known nutrient values at the time of application. Testing of the manure shall include an analysis for total nitrogen and total phosphorus. The analysis results can be converted to pounds of nutrients per ton for solids and/or pounds of nutrients per 1000 gallons for liquids. Note: Once historical laboratory manure analysis data is established, annual analysis is not required unless operational changes occur with manure storage facilities, storage intervals, feed rations and other situations.

Recommended procedures for collecting and preparing manure samples can be referenced in ***Appendix B of this standard***.

Manure Nutrients: Application Rate Limitations

The application rate (in/hr) for material applied through irrigation shall not exceed the soil intake/infiltration rate. The total application shall not exceed the field capacity of the soil.

The planned rates of manure or organic by-products applied as a source of plant available nitrogen and phosphorus shall be determined based on guidance as outlined in following sections. More information about manure nutrient application rates can be referenced in Chapter 3 of the NRCS Agricultural Waste Management Field Handbook.

Estimated ***crop nutrient removal values approved by NRCS can be referenced in Appendix A, Table 6*** of this standard.

Manure Volume - Expected Land Application Rates of Manure Based on Volume Limitations

The plant available nutrient amounts in manure can vary due to time in storage, storage methods, ration content and other reasons.

- avoiding winter nutrient application for spring seeded crops unless nutrient availability to the crops can be timed with subsequent emergence and growth,
- band applications of phosphorus near the seed row,
- applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques, and/or
- immediate incorporation of land applied manures or organic by-products,
- delaying field application of animal manures or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.

Consider minimum application setback distances from environmentally sensitive areas, such as sinkholes, wells, gullies, ditches, surface inlets or rapidly permeable soil areas.

Consider the potential problems from odors associated with the land application of animal manures, especially when applied near or upwind of residences.

Consider nitrogen volatilization losses associated with the land application of animal manures. Volatilization losses can become significant if manure is not immediately incorporated into the soil after application.

Consider the potential to affect listed or eligible cultural resources in the State or National Register.

Consider using soil test information no older than one year when developing new plans, particularly if animal manures are to be a nutrient source.

Consider annual reviews to determine if changes in the nutrient budget are desirable (or needed) for the next planned crop.

On sites on which there are special environmental concerns, consider other sampling techniques. (For example: Soil profile sampling for nitrogen, Pre-Sidedress Nitrogen Test (PSNT), Pre-Plant Soil Nitrate Test (PPSN) or soil surface sampling for phosphorus accumulation or pH changes.)

Consider ways to modify the chemistry of animal manure, including modification of the animal's diet to reduce the manure nutrient content and to enhance the producer's ability to manage manure effectively.

PLANS AND SPECIFICATIONS

Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s), using nutrients to achieve production goals and to prevent or minimize water quality impairment.

The following components shall be included in the nutrient management plan:

- aerial photograph or map and a soil map of the site,
- current and/or planned plant production sequence or crop rotation,
- results of soil, plant, water, manure or organic by-product sample analyses,
- realistic yield goals for the crops in the rotation,
- quantification of all nutrient sources,
- recommended nutrient rates, timing, form, and method of application and incorporation,
- location of designated sensitive areas or resources and the associated, nutrient management restriction,
- guidance for implementation, operation, maintenance, record keeping, and
- complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

If increases in soil phosphorus levels are expected, plans shall document:

- the soil phosphorus levels at which it may be desirable to convert to phosphorus based implementation,
- the relationship between soil phosphorus levels and potential for phosphorus transport from the field, and
- the potential for soil phosphorus drawdown from the production and harvesting of crops.

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APPENDIX A

Table 1 - Manure and Nutrients As Excreted Per 1000-lb. Live Weight/Day

Animal Type	Volume of Manure (cu.ft.) 1/	Dry Matter Manure (lbs)	Total Nitrogen (lbs)	Total P as P_2O_5 (lbs)	Total K as K_2O (lbs)
Beef (all cattle and calves) 2/	1.00	8.5	.34	.21	.25
Dairy Cows 2/	1.32	12.0	.45	.21	.35
Dairy Heifers 2/	1.30	12.0	.45	.21	.35
Swine – Lactating Sows w/litters 2/	.96	11.0	.52	.41	.35
Swine – Gestating Sows, Boars, Gilts 2/	.50	5.5	.26	.20	.17
Swine – Nursery and Finishing Pigs 2/	1.70	11.0	.52	.41	.35
Poultry Litter - Layer 2/	.93	16.0	.84	.69	.36
Poultry Litter - Breeder Layer 2/	.93	16.0	.84	.69	.36
Poultry Litter - Pullet 3/	.73	11.4	.62	.55	.31
Poultry Litter - Breeder Pullet 3/	.73	11.4	.62	.55	.31
Poultry Litter - Broiler 2/	1.26	22.0	1.10	.69	.48
Horses 3/	.80	11.0	.28	.11	.23
Sheep and Lambs 3/	.62	10.0	.45	.16	.36

1/ Poultry litter weighs about 27 lbs/cu ft (considering bedding). Swine, dairy, beef , horses and sheep waste (solids) weighs about 60 lbs/cu ft. Liquids weigh about 62.4 lbs/cu ft.

2/ Adapted from 1993 ASAE Standards. Reference: University of Kentucky (IP-57) *Potential for Livestock and Poultry Manure to Provide the Nutrients Removed by Crops and Forages in Kentucky*, Issued 9-1999

3/ Adapted from 1992 NRCS Agricultural Waste Management Field Handbook.

APPENDIX A

Table 3 - Percent of Nutrients from Manure Available to a Crop During the Year of Application in Comparison with Fertilizer Nutrients

(Based On Application Conditions) [1/]

Nutrient	Availability Coefficient	
	Poultry or Liquid	**Other Manures**
Nitrogen		
Corn & Others: Corn, Tobacco, Annual Grasses or Sorghum		
Spring Applied		
Incorporation: 2 days or less	0.60	0.50
Incorporation: 3-4 days	0.55	0.45
Incorporation: 5-6 days	0.50	0.40
Incorporation: 7 days or more	0.45	0.35
Fall Applied		
w/o cover crop	0.15	0.20
w/ cover crop	0.50	0.40
Small Grains (pre-plant)	0.50	0.40
Pasture (Fall or early Spring)	0.80	0.60
Phosphate	0.80	0.80
Potash	1.00	1.00

[1/] Note: Information from Table 2 or from a laboratory analysis will be used as a basis for Table 3.

Table 3 Source: AGR-146 "Using Animal Manures as Nutrient Sources" 8/2000 University of KY.

APPENDIX A

Table 6 - Crop Nutrient Removal Values*

	Nutrients Removed (lbs/yield unit)				
Crop	Yield Unit	Lbs per Yield Unit	Total Kjeldahl Nitrogen	P_2O_5	K_2O
Alfalfa hay [1/]	Ton	2000	50.00	14.000	55
All other cool season grass/legume hay (except alfalfa) [1/]	Ton	2000	35.00	12.000	53
Rye for grain [2/]	Bushel	56	1.16	.330	.32
Oats for grain [2/]	Bushel	32	.62	.250	.19
Barley for grain [2/]	Bushel	48	0.90	0.410	0.30
Corn for grain [1/]	Bushel	56	0.70	0.400	0.35
Corn for silage or green chop [1/]	Ton	2000	7.50	3.600	8.0
Winter wheat for grain [1/]	Bushel	60	1.20	0.500	0.30
Sorghum for grain [1/]	Bushel	56	0.95	0.410	0.30
Soybean for beans [1/]	Bushel	60	3.00	0.700	1.10
Tobacco, burley [1/]	Pound	1	0.07	0.011	0.075
Tobacco, dark air-cured [1/]	Pound	1	0.07	0.006	0.06
Tobacco, dark fire-cured [1/]	Pound	1	0.07	0.006	0.06
Forage from pastureland [3/]	Ton	2000			
Big Bluestem, Indiangrass, Little Bluestem, Switchgrass [4/] hay	Ton	2000	20.00	6.800	25
Bermudagrass [4/] hay	Ton	2000	37.60	8.700	33.6
Reed Canary Grass [4/] hay	Ton	2000	27.00	8.200	25

APPENDIX B

MANURE SAMPLING PROCEDURES

For laboratory testing, manure can be handled as a solid, semi-solid, or liquid. Semi-solid manure usually requires thorough agitation before pumping and sampling.

When to Sample

Sample manure as close to the time of land application as possible. Sampling at the time of application will not provide manure recommendations that can be used to adjust the amount of manure applied. However, the results can be used to adjust the amount of inorganic fertilizer applied and can also be used at the next application event. If you apply manure several times a year, sample when you apply the bulk of the manure. Ideally, manure sampling should be done in the field as manure is applied. This ensures that losses that occur during handling, storage, and application are taken into account.

Manure Sampling in the Field

Dry or Solid Field Sampling. To sample manure from barns, holding areas, dry stacks, or feed lots, collect a sample as follows:

Use the "hand and bag" method to collect all solid manure samples. Place a one-gallon re-sealable freezer bag turned inside out over one hand. Grab a handful of manure with covered hand and turn the freezer bag right side out over the sample with the free hand. Seal the bag and place it in another freezer bag to prevent leaks. Label the bag and send to the lab or freeze it immediately to prevent nutrient losses. Take three samples for dry or solid manure. Combine the samples and mix. Place in zip-lock bag.

Liquid Manure Sampling

When sampling liquid manure agitate the manure in the storage facility to obtain a representative sample for laboratory analysis.

Liquid Manure Applied with Spreaders

1. Immediately after filling the tank spreader, use a clean plastic bucket to collect manure from the unloading port or the opening near the bottom of the tank. Be sure the opening does not have solids accumulated that can contaminate the samples.

2. Stir the manure in the pail and immediately fill a one-quart flexible plastic bottle about 25 percent full. Do not use a glass bottle as it might explode from pressure build-up. Squeeze as much air out of the bottle as possible before capping.

3. Put your name, date and sample number on the bottle and the information sheet.

4. If the sample cannot be sent to the laboratory within a few hours, it should be refrigerated. Place the sample in a plastic bag, seal the bag, and keep cool until it is sent to the laboratory. Ship so that the sample arrives promptly at the laboratory.

Samples should be shipped express mail to the lab the same day they are collected. If not, they should be refrigerated immediately. It is advisable to keep samples on ice even during shipment to the laboratory.

APPENDIX B

LITTER SAMPLING PROCEDURES

All litter is not managed the same way. Nutrient content can vary considerably. Every poultry producer should have his or her litter analyzed for nutrient content. If the litter is fed to cattle, an analysis is critical. Litter is fed to cattle for crude protein and ash content. Litter with a crude protein content of 28 percent and an ash content less than 15 percent is ideal for feeding. Since calcium, phosphorus, potassium and trace minerals make up about 12 percent of the ash content, anything above that amount is probably soil. Since soil is worthless for feed, care must be taken when removing litter from the houses.

Sample Collection

General Sampling. Several small samples should be collected in clean 5 gallon buckets. Mix the contents of the 5 gallon buckets for a composite sample. Place a one-gallon resealable freezer bag turned inside out over one hand. Grab a handful of manure with covered hand and turn the freezer bag right side out over the sample with the free hand. Seal the bag and place it in another freezer bag to prevent leaks. Label the bag and send to the lab or freeze it immediately to prevent nutrient losses. Label the bags with permanent marker as follows:

1. Name
2. Address
2. Address
3. Type of chicken
4. Number of flocks representing the sample
5. House number
6. Method of sampling (in-house, from stack, during loading, in-field)

As a precautionary measure include the same information on a 3 by 5 card and place inside the outside freezer bag.

Other Methods of Sampling

In-House. Ten to 15 samples are collected throughout the house before cleanout. Three to four samples should be collected under or near the waterers and the rest collected throughout the remainder of the house. Dig only as deeply as you plan to scrape. Be careful not to include any soil in the sample. This method of sampling will allow reports back before land application so that an appropriate land application amount can be determined. This method is labor intensive.

During cleanout. Samples are collected as litter is loaded onto the spreader or as it is temporarily stockpiled prior to spreading. Individual samples should be collected throughout the cleanout. This method of sampling will not allow time for lab results return before land application occurs. This method will reflect an analysis of what is actually scraped out of the houses.

During spreading. A plastic sheet or gallon plastic jugs cut in half are placed in the field to collect litter as it is spread. This method is most accurate. This method will not allow time for lab results to be returned in time. However, results can be used the following application event.

Stockpile. Litter stored for a period of time is subject to heat and this can change its chemical characteristics. Since temperatures will peak in 10 to 20 days after initial stacking, samples should be collected after the temperature drops and as close to spreading or feedings time as

APPENDIX C

KENTUCKY PHOSPHORUS (P) MATRIX

COMMERCIAL FERTILIZERS, ANIMAL MANURES AND ORGANIC BY-PRODUCTS

OPTION 1 *

Kentucky Environmentally Sensitive Soil Test Phosphorus Threshold (PT)

(PT) = 533 lbs (P) per Acre

Soil Test Phosphorus = (STP)

(OR)

OPTION 2 *

Kentucky

Phosphorus Index Rating

Below ¾ PT
(Below 400 STP) – (N) Based
Above ¾ and Below 1-1/2 Times PT
(400-800 STP) – (P) Crop Removal

Above 1-1/2 and Below 2 Times PT
(801-1066 STP) – (P) ½ Crop Removal

Above 2 Times PT
(Above 1066 STP – No Application)

Low Risk – (N) Based
Medium Risk – (N) Based

High Risk – (P) Based
(Crop Removal)

Very High Risk – (P) Based
(No Application)

*Note: A nitrogen (N) based plan can be implemented when STP is below 400. When STP is equal to or greater than 400, the use of either Option 1 or Option 2 is required in all cases.

APPENDIX C

Also assigned to each of the ten features are ***value ratings*** of LOW (1 point), MEDIUM (2 points), HIGH (4 points), or VERY HIGH (8 points). Multiplying the ***weighted factor*** by the appropriate ***value rating*** yields points for that specific field feature. Based on a summation of the field feature points, the field falls into an overall category rating of LOW, MEDIUM, HIGH, or VERY HIGH. If a field receives an overall rating of HIGH or VERY HIGH, management practices may be implemented to reduce the rating to MEDIUM.

Field Features and Weighted Factors Used in the P Index

Field Features	Weighted Factor
1. Hydrologic Soil Group	1
2. Residual Soil Test (P) Level	3
3. Field Slope Percent	1
4. Land Cover Percent	3
5. Vegetative Buffer Width	3
6. Agricultural Impaired Watershed	1
7. Application Timing	3
8. Application Method	3
9. Distance To Spring/Stream/Waterbody	2
10. MLRA (County Location)	1

Currently, these weighted factors are based on the professional judgment of the various technical specialists who contributed to the development of the NRCS standard (590). As more research becomes available, the P Index will be periodically reviewed and updated.

Description of Field Features and Rating Assignments

1. ***Hydrologic Soil Group*** **(HSG)** considers the drainability of the soil. A soil with a HSG of "A" is well drained. A soil with a HSG of "D" is poorly drained. A soil that is poorly drained is more likely to have runoff occur. HSG is given a weighted factor of 1.

2. ***Residual Soil Test (P)*** considers the level of (P) in the soil prior to the application of nutrients. This level is determined by a current soil test analysis. A current soil test analysis is less than 1 year old. As soil test levels increase following repeated applications, the index points will need to be recalculated. Soil test (P) is given a weighed factor of 3.

3. ***Field Slope Percent*** considers the average percent of slope for the field. Field slope is given a low weighted factor of 1 because it is considered in the Erosion Rate.

4. ***Land Cover Percent*** considers the percent ground cover (average over the field) immediately following the waste application. The waste application may be surface applied, injected or incorporated. Ground cover is considered to be perennial sod or crop stubble that is evenly spread over the soil surface of the application field/s. Perennial sod shall have a minimum of 3-4 inches of plant height. Land cover is given a low weighted factor of 3 because it is also considered in the application of erosion control practices.

5. ***Vegetative Buffer Width*** considers the filtering effect of vegetative buffers at downstream edges of fields. Filtering effect must be from sheet flow across the buffer. Filter strips, field borders, contour buffer strips, and riparian forest buffers are all examples of vegetative buffers. Due to the vast amount of favorable research that reinforces the effectiveness of buffers, this feature is given a weighted factor of 3.

6. ***Application Area is in a Watershed Identified as Being Impaired Due to Agricultural Applied Nutrients.*** These areas are identified on state supplied listings. If the application fields are in the watershed as identified on the list currently on file in NRCS offices, a weighted factor of 1 is assigned.

APPENDIX C

Kentucky Phosphorus Index *Multiplying the **weighted factor** by the **value rating**, yields points for that specific field feature.*				
Field Features (weighted factors in parenthesis below)	**Field Feature Value Ratings**			
	Low (1 point)	**Medium** (2 points)	**High** (4 points)	**Very High** (8 points)
1. Hydrologic Soil Group (1.0)	A	B	C	D
2. Residual Soil Test (P) Level (3.0)	Between 400-500	Between 501-800	Between 801-1066	Above 1066*
3. Field Slope Percent (1.0)	<2	2-5	6-12	>12
4. Land Cover Percent* (3.0) *estimated after application	60-90	30-60	15-30	0-15
5. Vegetative Buffer Width (3.0) (ft)	>29	20-29	10-19	<10 or No Buffer
6. Application Area Is In A Watershed Identified As Being Impaired Due To Agricultural Applied Nutrients (1.0)	NO			YES
7. Application Timing (3.0)	June - Sept	April, May, Oct., March or Nov. w/ winter cover	March or Nov. w/o winter cover, Feb. w/ winter cover	Dec., Jan., Feb.
8. Application Method (3.0)	Injected	Surface applied and incorporated within 48 hr.	Surface applied and incorporated within 1 month	Surface applied and unincorporated for greater than 1 month
9. Downstream Distance From Application Area To Spring, Stream or Waterbody (2.0)	Over 150	50-150	0-50	Adjacent
10. MLRA (County Location) (1.0)	Bluegrass	All Other		

Note: Additional Phosphorus Will Not be Applied When Soil Test (P) Level is above 1066.

APPENDIX C

Field Vulnerability for Phosphorus Loss	
Total Points from P Index	**Generalized Interpretation of P Index**
< 30	**LOW** potential for P movement from the field. Low probability of an adverse impact to waterbodies.
30 - 60	**MEDIUM** potential for P movement from the field. The chance of organic material and nutrients getting into waterbodies exists. Buffers, setbacks, lower manure rates, cover crops, crop residue practices alone or in combination may reduce impact.
61 - 112	**HIGH** potential for P movement from the field. The chance of organic material and nutrients getting to waterbodies is likely. Buffers, setbacks, lower manure rates, cover crops, crop residues, etc. in combination may reduce impact.
> 112	**VERY HIGH** potential for P movement from the field and an adverse impact on waterbodies.

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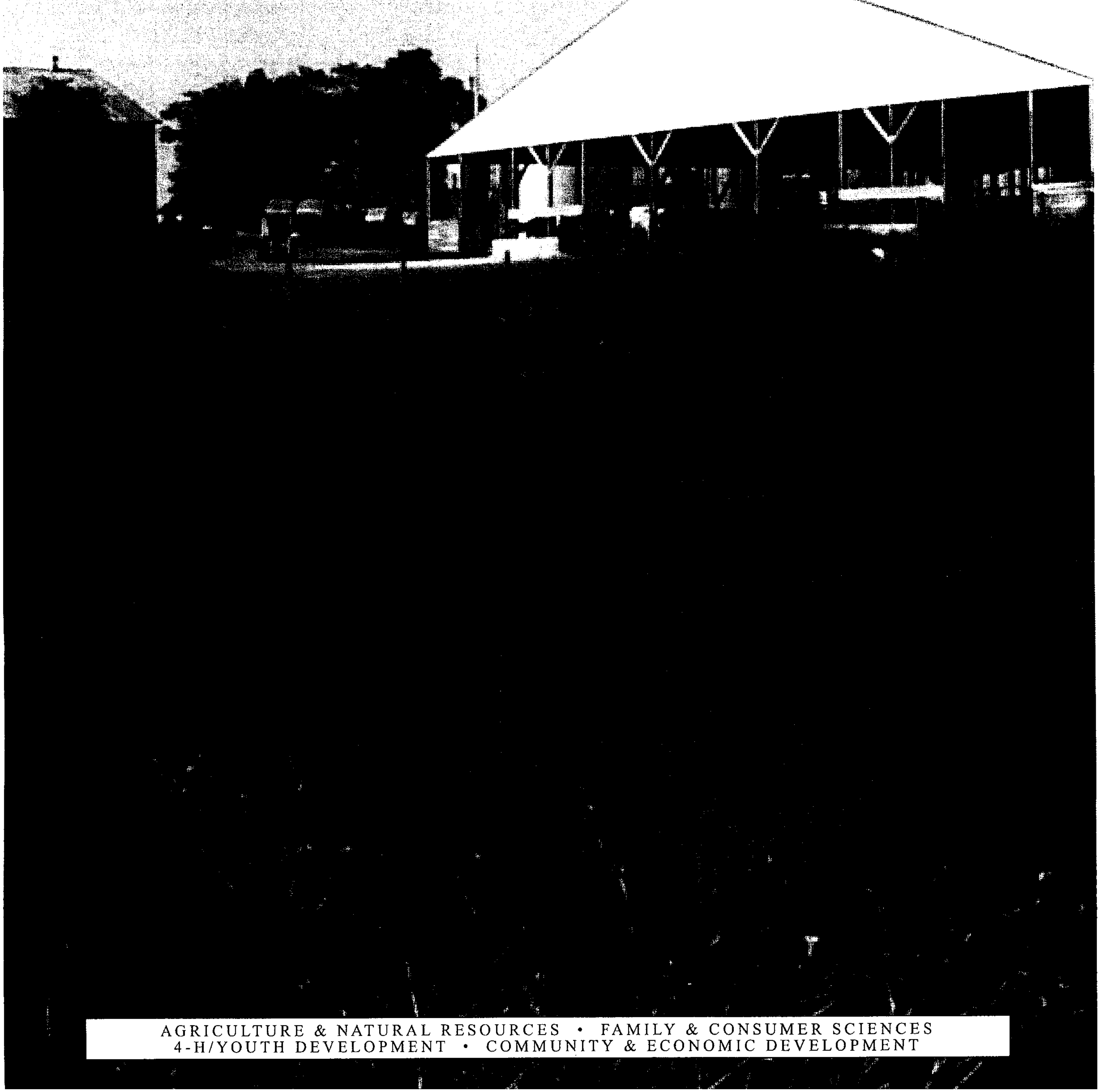
IP-71

COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

Nutrient Management in Kentucky

Nutrient Management Focus Group, Environmental and Natural Resource Issues Task Force



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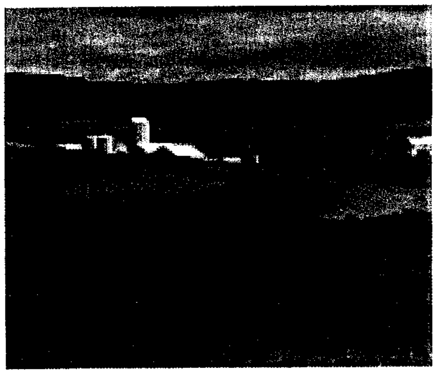

Photo courtesy of USDA NRCS.

Nutrient Management in Kentucky

Nutrient Management Focus Group, Environmental and Natural Resource Issues Task Force

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Implementing a nutrient management plan can save on fertilizer costs while protecting water quality. The objective of nutrient management is to use nutrients (mainly nitrogen, phosphorus, and potassium) wisely for optimal economic benefit to the farmer while minimizing impact on the environment. Nutrients are essential for the growth of crops and must be supplied to plants in adequate amounts to achieve satisfactory yields and profits. Excessive application of fertilizers or manure can contribute to pollution of streams and groundwater resources and generally reduce profitability. A properly implemented nutrient management plan can assure the farmer that the correct amounts of nutrients are being utilized in the most efficient manner.

Nutrients on a farm can be cycled, accumulated, or passed through. They can come onto a farm in the form of feed, commercial fertilizers, manure, or compost. Nutrients leave the farm through harvested crops, livestock sold, or manure moved off the farm, or they can be lost through the air or water. Some crops have the ability to fix nitrogen from the atmosphere and thereby contribute to the nutrient content of the soil. Grazing animals cycle nutrients in pasture systems by consuming forage and then depositing nutrients back to the land in the form of manure and urine.

As a nutrient plan is developed, the long-term balance of soil fertility, plant uptake, and removal of nutrients and the potential loss of nutrients to the environment should be considered. An appropriate goal for the nutrient plan is to maintain a productive, fertile farm. A trend that indicates a decrease in the nutrient status of the farm means there will be a need to add nutrients in the future. A trend that suggests a continuing buildup of nutrients indicates a supply in excess of plant needs and will likely require a change in management to improve farm profitability and avoid potential environmental harm.

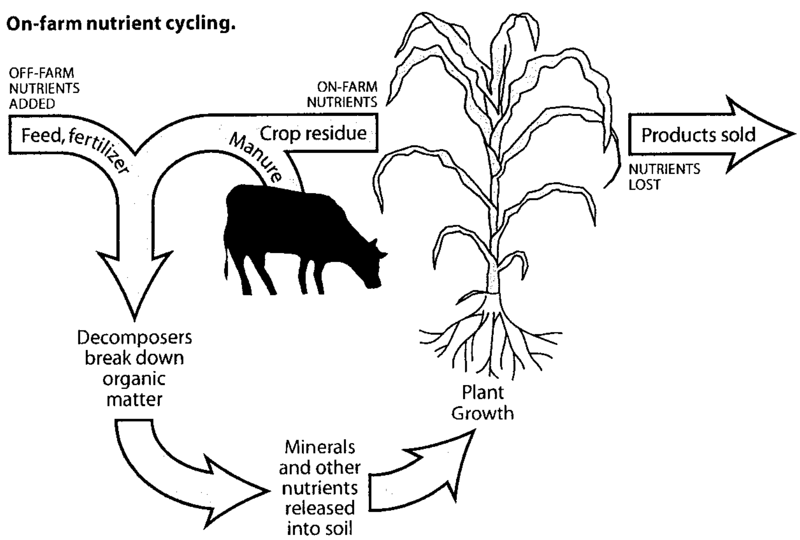
This publication will look at these trends and other factors that must be considered when developing a nutrient management plan. Carefully planning how nutrients are managed will help protect the long-term sustainability and profitability of the farm.

What Is a Nutrient Management Plan?

A nutrient management plan is an accounting of all nutrients present on the farm as well as all of the nutrients coming onto the farm in the form of commercial fertilizers or manure. The plan balances these nutrients with the amount of nutrients required for crop growth. Components of a nutrient management plan include:

- Soil maps with field designations.
- Crop plan.
- Conservation practices plan.
- Manure collection and storage facilities.
- Manure nutrient content.
- Manure utilization plan.
- Records, including soil tests, fertilizer recommendations, manure applications, and yield estimates.

On-farm nutrient cycling.



Adapted from: Natural Nutrient Cycle—1998 Project Food, Land, and People; Farm Nutrient Cycle—Douglas Beegle, The Pennsylvania State University

Nutrient Sources

Livestock Manure

The nutrient content of animal waste is quite varied and often specific to animal type. Manure quality depends on the nutritional quality of the animals' feed, handling of the manure, and storage conditions.

Commercial Fertilizers

Plant nutrients are often supplied to agricultural systems in the form of chemical fertilizers. Nitrogen, phosphorus, and potassium are the three primary nutrients added to cropping systems, although many other nutrients may be used to promote plant growth and development. When commercial fertilizers are applied at rates that exceed the plants' ability to remove the nutrients at a given growth stage, fertilizer runoff can occur. This runoff may be harmful to nearby water resources and is a waste of fertilizer.

Crop Residues

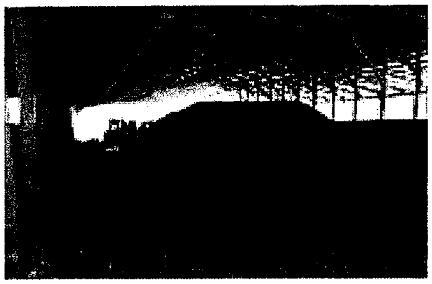
Crop residues contain valuable nutrients that can be left in the field to build soil organic matter. Crop residues decompose to provide nutrients over time. This slower release of plant nutrients reduces the risk of nutrient runoff.

Soil Mineral Weathering

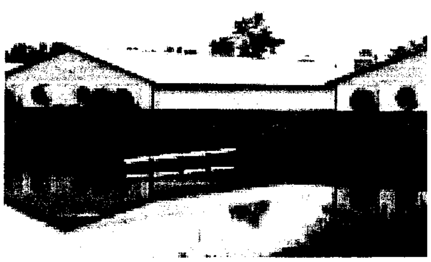
The weathering of minerals (rocks) in the soil can be a source of nutrients, especially phosphorus and potassium. This is particularly of interest in the Bluegrass region of Kentucky, where phosphorus is naturally present in high concentrations in the soil.

Atmosphere

Some plants, such as legumes, maintain symbiotic relationships with bacteria that can fix atmospheric nitrogen. Fixed nitrogen is available for the host plant and sometimes non-fixing plants grown in association with nitrogen-fixing plants. However, plants will preferentially uptake mineral forms of nitrogen when available, such as from chemical fertilizers.



A covered structure provides manure storage until the appropriate application time.



A lined earthen basin is an appropriate storage structure for liquid manure.

Liquid manure applications may be applied within 30 days of the beginning of crop growth unless heavy precipitation is forecast before the liquid could be absorbed into the soil profile.

Apply animal manure when the crop can best use the nutrients it supplies.

Manure Storage Systems

A storage facility in an animal manure management system allows a producer control over the timing and scheduling of land application when:

- It does not interfere with other farm work.
- Field conditions are not too wet or frozen.
- Favorable weather conditions may reduce off-farm odor complaints.

The storage capacity should be based on these considerations. In Kentucky, a minimum storage capacity of 120 days is recommended to store the manure through the winter months when field conditions are often poor for application. In general, 12-month storage capacity for liquid manure systems gives the optimal flexibility for the situations cited above. If storage capacity is too small, the facility will fill before the manure nutrients can be used in an environmentally sound manner.

A manure storage system can be:

- A covered stack pad for solid manure with leachate collection.
- An above- or below-ground tank for liquid manure.
- A lined earthen basin to store or treat large volumes of liquid manure.

Selecting the most appropriate storage system depends on available capital and labor, manure sources, animal production system, soil type, cropping practices, topography, neighbors, convenience, aesthetics, and regulations. All storage systems are balances and compromises among these competing priorities. Economics and environmental regulations are key considerations when choosing a manure storage system.

Other items to consider are the amount and type of land available for application, fresh water resources, and required odor control measures. The manure storage system selected should not be based solely on available equipment and facilities. All items should be considered to avoid costs associated with inefficient manure handling.

Stored manure nutrients can be applied to the land by:

- Surface application with a box or tank spreader wagon, followed by a light tillage operation to increase nitrogen retention and reduce odors.
- Liquid injection from tank wagons.
- Irrigation with an option to incorporate the nutrients into the soil.
- Towed hose, continuous injections with tractor-mounted tool bars.

Irrigation reduces soil compaction and increases time available for manure application since post-planting application can occur. Land application can be performed by custom applicators. It reduces capital expenses and labor, but timeliness of application could be limited by the availability of an operator. Irrigation has the drawback of increased odor production.

Planning Manure Applications for Crop Production

Soil testing is the foundation of a sound nutrient management program.

Sample manure as close to the time of land application as possible.

Step 1. Soil Testing

Planning should start with taking a representative soil sample from the field and having it tested to determine the current fertility status. Soil pH, phosphorus, and potassium are the primary factors to consider. Other nutrients, such as calcium, magnesium, and organic matter, could be useful also, especially for long-term comparisons. Testing should be done by the University of Kentucky Soil Testing Laboratory. Other laboratories may be used if they have the same procedures as the University of Kentucky Soil Testing Lab. Extension publication AGR-1, *Lime and Fertilizer Recommendations*, lists the testing method used to develop soil test recommendations in Kentucky.

County Extension offices can provide information on how to take soil samples. They can also provide sample containers, record forms, and, in some cases, soil probes for taking samples. They will arrange to have samples tested and provide fertilizer recommendations based on the results. Soil samples should be taken well ahead of the time that manure applications are planned. It will take several weeks to get samples taken, have them tested, and determine fertilizer recommendations. If spring applications of manure are planned, it is a good idea to take samples in the fall. Likewise, soil samples taken in the spring will give time to plan manure applications for fall.

A good soil test is the only way to be sure enough nutrients are available for crop needs and to prevent the levels of some nutrients from becoming high enough to threaten water quality.

Step 2. Manure Testing

Although average "book values" of the nutrient content of manures can be used for short-term planning of manure application rates, farmers need to determine more accurate values for the manure they will be using in order to develop good long-term plans. This means that manure samples should be taken as soon as possible in the planning process to get a representative sample. In the case of broiler litter to be applied as soon as it is removed from the house, samples can be taken in the house between the last two flocks raised just prior to cleanout. However, if the litter is to be stacked for some time before it is to be applied, samples should not be taken until a few weeks before it is to be applied because nutrient content changes during storage.

Varying Nutrient Needs

Some examples of varying nutrient needs based on the factors mentioned are:

***Crop**—Corn and soybeans have very different needs. Corn must have nitrogen supplied, while soybeans obtain their own through nitrogen fixation.*

***Yield**—A 200-bushel per acre corn crop requires much higher fertility than a 100-bushel corn crop.*

***Soil type**—The predominant soil type in a field affects yield potential and the availability of nutrients to crops. Soil characteristics such as depth, drainage, and ability to supply moisture are important.*

***Previous crop**—Some crops, especially sod crops, build up nitrogen that can become available to succeeding crops.*

***Prior manure applications**—Some of the nitrogen in manure is released slowly as the manure decomposes. This nitrogen will become available a year or more after it is applied.*

***Soil test**—Results of a good soil test show what is already in the soil's nutrient "bank." These nutrients can be drawn on to provide for the needs of the next crop. Without a soil test, either an "overdraft" or excess of nutrients is likely to occur.*

For liquid manure systems, such as holding ponds or lagoons, the best time to get a representative sample is when the manure will be agitated during pumping prior to application. Sampling at this time means the test results cannot be used to plan current application rates. This is a case where book values can be used for the short-term, then modified in the future based on the sample analyses. It should be remembered that a bad sample (one that does not represent the manure being applied) is much worse than no sample at all because it can lead to poor long-term nutrient management.

Information on sampling and testing animal manure is available in Extension publication ID-123, *Livestock Waste Sampling and Testing*. This publication and other information regarding the utilization of animal manure as a nutrient source is available at county Extension offices.

Step 3. Determining Crop Nutrient Needs

The nutrients that need to be applied to grow a crop depend on:

- The crop to be grown.
- Realistic yield goals.
- Predominant soil type and drainage.
- The previous crop.
- Prior manure applications.
- Soil test results.

Fertilizer recommendations made by the University of Kentucky Cooperative Extension Service take all of these factors into consideration. Other factors such as nutrient source (commercial fertilizer or manures), timing, and method of application can also affect the application rate. Extension publication AGR-1, *Lime and Fertilizer Recommendations*, can be used to determine crop nutrient needs.

Step 4. Calculate Manure Application Rates

The rate of manure to apply for a particular crop depends on:

- The nutrient needs of the crop as determined in Step 3.
- The nutrients available from the manure to be used.
- Selecting a nutrient to base the application rate on. Rates are usually based on how much nitrogen or phosphorus the crop needs.

Information on how to calculate manure application rates for crops grown in Kentucky is given in Extension publication AGR-146, *Using Animal Manures as Nutrient Sources*. A worksheet is included that takes into account the nutrient recommendations, any residual nitrogen from manure, nutrients in pre-plant fertilizer, and the availability of nutrients in manure. A manure rate can then be calculated to supply either the nitrogen, phosphorus, or potassium recommended for the crop. A balance sheet also can be used to determine if additional nutrients are needed. Computer-based spreadsheet programs are also available to calculate application rates.

Manure should not be applied on frozen or snow-covered fields where subsequent rains could wash the manure off the field before it has a chance to move into the soil.

It must be remembered that nutrients in manure, especially nitrogen, are not as readily available to crops as nutrients in commercial fertilizers. Therefore, it is necessary to calculate manure rates based on nutrient availability to be sure crop nutrient needs are met.

Step 5. When Should Manure Be Applied?

The most important factor in determining when manure should be applied is *when the crop can best use the nutrients.* For annual crops such as corn, this usually means spreading manure just before seeding. For perennial crops, such as pasture or hay, timing of application is much more flexible. Most Kentucky farms have some fields that manure can be applied on during any season. Following are some examples:

Spring is the best time to spread manure for a summer crop such as corn.

- **Fall**—Kentucky has large acreages of cool-season pasture and hay fields that could benefit from fall applications of manure. Wheat fields and crop fields with cover crops are also good choices. Manure should not be applied in fall on crop fields that do not have a cover crop to take up and hold nitrogen.
- **Winter**—Opportunities for manure application in winter are limited. The best options are on cool-season forages and small grains in February or March. Manure should not be applied on frozen or snow-covered fields where subsequent rains could wash the manure off the field before it has a chance to move into the soil. Manure should not be applied in winter on crop fields that do not have a cover crop to take up and hold nitrogen.
- **Spring**—Spring is the best time to spread manure for a summer crop such as corn. Manure spread in early spring will lose less nitrogen and have the most nutrients available at the time the crop needs them. Spring is not the best time for applying manures to cool-season forages, especially after early April. Nitrogen losses from the manure will be greater at this time, and weed competition could be increased.
- **Summer**—Manure spread in the summer will have the greatest risk of nitrogen loss through ammonia volatilization. However, if storage facilities need to be emptied, there are options for use. Manure can be applied on alfalfa fields during summer. Select fields with older stands of alfalfa, and apply manure as soon after harvest as possible. Warm-season grass fields used for hay are one of the best options for manure application in summer. Sudangrass responds well to manure applied following harvest in July or August. Manure can be applied on bermudagrass fields any time after a harvest during the summer. Bermudagrass is a heavy user of nutrients, and if it is removed as hay, nutrient accumulation in the soil is reduced.

Manure should be applied close to the time the crop will need the nutrients it supplies. In order to accomplish this, it will be necessary for some farmers to store manure for several months. This need should be taken into account when planning for an animal production enterprise.

The Nutrient Value of Manure

The value of manure is highly dependent on the nutrient status of the field to which it is applied, the nutrient content of the manure, the nutrient needs of the crop to be grown, and the comparative cost of purchasing nutrients from other sources.

The value of any nutrient source is greater when applied to a soil that has a low soil test level for the nutrient(s) being supplied. Manure nutrients in excess of the amount recommended from a soil test are not given any value for comparison. Analysis of a manure sample will determine its nutrient content. Depending on the animal species, manure storage methods, and land application methods, the relative amount of nutrients available to plants can be estimated.

An economic value can be assigned to manure by multiplying these estimates by the cost of purchasing nutrients as commercial fertilizer. This gross value does not reflect differences in the cost of applying manure to the land versus the cost of applying commercial fertilizer. It is not advisable to determine an economic value of manure based on book or average values because nutrient content can vary greatly due to animal species, manure collection and storage, composition of livestock rations, amount of bedding, and the amount of water added.

Annual applications of manure will also add organic matter to the soil. However, this added value is inconsistent and difficult to determine but does provide an additional benefit to the soil.

The greatest benefits from any nutrients applied to the land are derived when those nutrients remain where they were placed.

Nutrient and Manure Use Benefits from Conservation

The greatest benefits from any nutrients applied to the land are derived when those nutrients remain where they were placed. A key factor for maximizing contributions to the soil is to minimize losses from runoff and erosion. Reducing the amount of runoff and erosion will also protect water quality of nearby streams and groundwater resources.

Minimizing water contamination involves reducing the amount of nutrients and manure sediment reaching the water body. Many conservation practices for the control of runoff and sediment movement have been developed, researched, and implemented. These practices include changes in land management and cropping, as well as the installation of complementary structural devices. Any of these practices used individually or in combination are effective in reducing nutrients and sediment from moving to surface water bodies.

Contour strip cropping is one practice that reduces non-point source loss of nutrients due to runoff and erosion.

Including crops with a high phosphorus demand in a rotation can help draw down soil phosphorus levels following manure applications and reduce potential phosphorus losses in runoff water.

Land Management Practices:	**Structural Devices:**
Cover crops	Grassed waterways
Diverse rotations	Vegetative filter strips
No-till	Terraces
Conservation tillage	Diversions
Contour farming	Grade stabilization structures
Contour strip cropping	

Crop Selection and Rotation

The selection of crops to include in a rotation has been shown to reduce nitrogen movement in soil profiles and lessen phosphorus buildup in the soil surface. Grass-type crops and legumes can effectively "scavenge" soluble nitrogen from previous crops or more recent manure applications. Also, crops with a low nitrogen requirement used in sequence either with previously grown crops that recover nitrogen ineffectively or that have a high nitrogen requirement can effectively reduce the amount of nitrogen needed over a number of years.

Including crops with a high phosphorus demand (alfalfa, corn silage, etc.) in a rotation can help draw down soil phosphorus levels following manure applications and reduce potential phosphorus losses in runoff water. Alfalfa's deep root system can also remove soluble nitrate-nitrogen from soils at greater depths than many other crops.

Cover Crops

Fall-seeded cover crops of small grains or forage grasses lengthen the time an active vegetative cover exists on a field. This vegetative cover reduces sediment in runoff and helps to slow water runoff, thus increasing infiltration. When used following a high nitrogen-requiring crop, the cover crop can usually satisfy its nitrogen needs by scavenging nitrogen from the soil. This practice is very effective in reducing nutrient runoff following row crops and fall manure application because it provides cover during much of the period of highest rainfall intensity.

No-Till and Conservation Tillage

A major objective for using no-till and conservation tillage is to manage crop residues to reduce runoff of water, nutrients, and sediment. Crop residues left on the soil surface can cover 60 to 100 percent of the land, depending on the timing, implement used, and tillage type. This residue cover reduces rainfall impact on the soil surface and slows runoff, which reduces the amount of nutrients and sediment reaching surface waters. Cover crops and contouring are often used with these tillage systems to further increase nutrient, water, and sediment retention.

Grassed waterways are able to slow water and filter out contaminants. They are often combined with buffer strips or stabilization structures.

Contouring

Contouring will create some impediments to water movement. Any type of land roughness (chiseling, crop rows, etc.) or vegetation changes (alternate crop strips, etc.) that slows or impedes water flow will decrease runoff of nutrients and sediment. On less sloping land, row crops are often grown in alternating strips with forages. The forages provide a change in vegetation and serve as a filter. Manure can be applied during fall or spring to the row crop strips while leaving the forage strips to act as filters. A greater reduction in runoff occurs when cover crops are used on the row crop strips.

Filter or Buffer Strips

These 30- to 100-foot wide "strips" of actively growing vegetation are located below or around fields. Some may be located adjacent to and along streams or riverbanks, above lake shores, or above farm ponds. These vegetative buffers or filters slow down runoff from land areas above and can trap nutrients and sediment. They function best under these conditions:

- They are clipped regularly to maintain a plant height of 3 to 6 inches.
- They consist of a thick stand of forage grasses.
- They are not used as field roads. Traffic on these buffers reduces the vegetative cover and promotes gully formation in the wheel tracks.

The Kentucky Agriculture Water Quality Act requires nutrient management plans on farms 10 acres or greater in size where nutrients are applied and/or utilized.

Grassed Waterways

These grassed areas collect, direct, and manage runoff safely from side slopes to areas lower on the landscape. They have some ability to slow water and filter out contaminants. They are often combined with buffer strips or stabilization structures in a lower landscape position, depending on the width of the relatively flat buffer areas or the need to have water dropped several feet into a ditch, stream, or river. Grassed waterways are frequently used in conjunction with contouring for safe runoff management. Nutrients should not be applied directly to grassed waterways.

Terraces, Diversions, and Stabilization Structures

These structures are used where significant landscape alterations are needed for safe water management. Terraces have some capacity to trap water for significant periods to allow sediment collection and water infiltration. Diversions serve to direct some water around more sensitive areas or areas with higher risk of soil loss as sediment. Frequently, the water is directed into grassed waterways for safe handling. Stabilization structures may range from simple to extensive stream bank stabilization, drainage tile outlets, and water overflow structures at the end of a grassed waterway.

Pastures Need Some Special Considerations

Nutrient cycling in pastures can be monitored by a good soil testing program (Photo courtesy of USDA NRCS).

When forages serve as the sole feed source in pasture systems, nutrients from the manure and urine of grazing livestock will not exceed the amount required by the forages. Livestock concentration in some areas of the pasture, except with rotational grazing, may result in uneven distribution of nutrients. Nutrients leave the pasture system only through animal growth or milk production. In general, only 25 to 30 percent of the nutrients taken in by grazing animals are removed from the field in this manner. The remaining 70 to 75 percent are returned to the pasture in the manure and urine. This recycling of nutrients should be monitored carefully by a good soil testing program. If nutrient management with pastures involves using a crop removal basis for determining the amount of phosphorus and potassium to apply, then only about 30 percent of the calculated amount should be applied. Otherwise, soil test levels may increase rapidly due to the excess of additions over that removed.

Nutrient Management Plans Are Required For:

Cost-share funds for any Best Management Practice (BMP) on Animal Feeding Operations (AFOs) through the Clean Water Act §319 Non-point Source Program.

Cost-share funds for any BMP on AFOs through the Clean Water Action Plan (CWAP).

Cost-share funds for animal nutrient management BMPs through the Environmental Quality Incentives Program (EQIP).

Cost-share funds for animal nutrient management BMPs through the Kentucky Soil Erosion and Water Quality Program.

Nutrient Management and Conservation

Conservation and nutrient management practices must be coordinated in order to protect surface and groundwater. Reduced tillage and erosion control practices are effective when sediment and any attached nutrients contribute to water contamination. By slowing runoff, water and any associated nutrients are given more time to soak into the soil. Effective crop management and diverse rotations are more important in managing nutrients within a soil profile.

Required Nutrient Management Plans

Nutrient management plans are required by regulation when applying for a Kentucky Pollution Discharge Elimination System (KPDES) Operating Permit for a Confined Animal Feeding Operation (CAFO).

Nutrient management plans are required under the Kentucky Agriculture Water Quality Act and State Agriculture Water Quality Plan on farms 10 acres or greater in size where nutrients (commercial fertilizers or animal manure nutrients) are being applied and/or utilized.

This publication was funded by an award received by the University of Kentucky from the U.S. Environmental Protection Agency to the Kentucky Division of Conservation through 319(h) Non-point Source Implementation Program Cooperative Agreement #C9994659-95.

Some publications that will provide more detailed information on many practices for nutrient management include:

AGR-1	*Lime and Fertilizer Recommendations*
AGR-16	*Taking Soil Test Samples*
AGR-57	*Soil Testing: What It Is and What It Does*
AGR-91	*Cropland Rotations for Kentucky*
AGR-97	*Surface Water Management Systems*
AGR-99	*Tillage and Crop Residue Management*
AGR-100	*No-Till Corn*
AGR-101	*No-Till Soybeans*
AGR-102	*Erosion: Its Effect on Soil Properties, Productivity, and Profit*
AGR-103	*Controlling Soil Erosion with Agronomic Practices*
AGR-144	*The Nature and Value of Residual Soil Fertility*
AGR-146	*Using Animal Manures as Nutrient Sources*
AGR-165	*The Agronomics of Manure Use for Crop Production*
ID-123	*Livestock Waste Sampling and Testing*

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Taking Soil Test Samples

W.O. Thom, G.J. Schwab, L.W. Murdock, and F.J. Sikora

The most important part of making fertilizer recommendations is collecting a good, representative soil sample. Soil test results and fertilizer recommendations are based solely on the few ounces of soil submitted to the laboratory for analysis. These few ounces can represent several million pounds of soil in the field. If this sample does not reflect actual soil conditions, the results can be misleading and lead to costly over- or under-fertilization. It is necessary to make sure that the soil sample sent to the laboratory accurately represents the area sampled.

Sample Timing

Soil samples can be collected through much of the year, although fall (September to December) or spring (February to April) are the best times. Fall sampling will often result in a faster return of results and recommendations. Fall sampling will also allow the grower time to have the fertilizer applied well before planting the next crop. However, fall sampling results in lower pH and soil test K levels when conditions are dry. In either case, a field should always be sampled the same time of the year in order to make historical comparisons.

Most fields should be sampled every three to four years. High-value crops, such as tobacco, commercial horticultural crops, alfalfa, red clover, and corn silage, should be sampled annually so that plant nutrient levels can be monitored more closely. Application of manure can change soil test phosphorus, potassium, and zinc levels dramatically, so sampling manured fields each year is also recommended.

Tools You Need

A soil probe, auger, garden trowel, or a spade and knife are all the tools you need to take the individual cores that will make up the "field" sample (Figure 1). You will also need a clean, dry, plastic bucket to collect and mix the sample cores. Be sure not to use galvanized or rubber buckets because they will contaminate the sample with zinc. Soil sample boxes or bags and information forms for submitting samples are available at all county Extension offices.

Collecting Field Crop Samples

An individual sample should represent no more than 20 acres except when soils, past management, and cropping history are quite uniform. The most representative sample can be obtained from a large field by sampling smaller areas on the basis of soil type, cropping history, erosion, or past management practices (Figure 2). For example, a portion of a field may have a history of manure application or tobacco production while the other part does not. Phosphorus and potassium levels will likely be higher in these areas, causing the rest of the field to be under-fertilized if the field is sampled as one

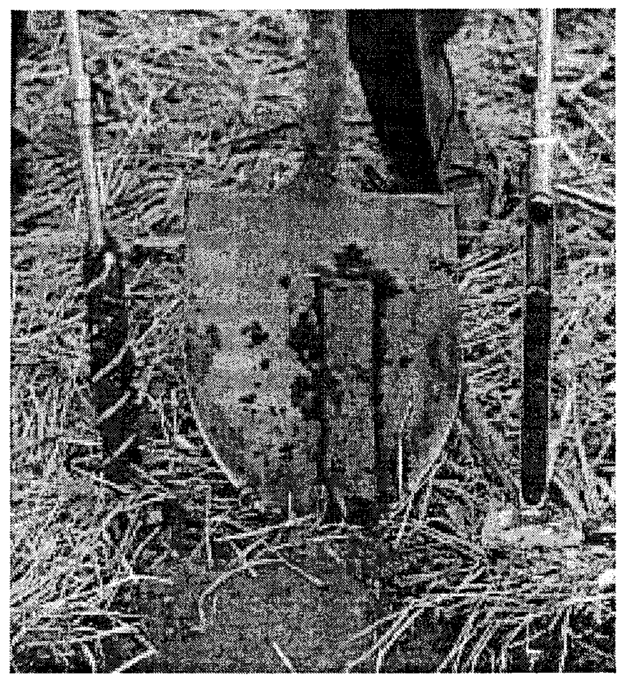

Figure 1. A soil probe, auger, or spade and knife should be used in sampling soils. The spade sample must be trimmed as shown.

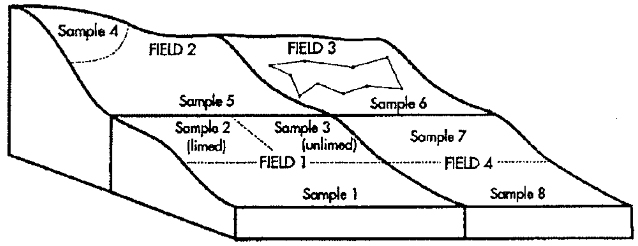

Figure 2. This shows how four fields might require the analysis of one to three composite samples for determining fertility needs. Each composite must contain 10 or more cores, as shown for Sample 6 in Field 3.

unit. It is much better to collect separate samples from these areas because their nutrient requirements are likely quite different from the rest of the field.

If a few years of yield maps are available, these can help identify areas of the field that should be sampled separately.

Soil sampling can also be used to "troubleshoot" areas of the field that are visually different or are consistently low yielding when compared to the rest of the field. Take a sample both from the poor growing area and adjacent areas of good growth. Keep good records indicating where each sample was taken.

Collect at least 10 soil cores for small areas and up to 30 cores for larger fields. Take the soil cores randomly throughout the sampling area and place them in the bucket. **Do not sample:**

- back furrows or dead furrows,
- old fencerows,
- areas used for manure or hay storage and livestock feeding, and
- areas where lime has been piled in the past.

Grid Soil Sampling

With new advances in agriculture and the availability of global positioning satellites, it is now possible to divide a field into smaller units or grid cells that can be sampled individually. Soil test results from each grid can be used to prepare nutrient availability maps of fields. Variable-rate fertilizer and lime applications are then based on these maps. Grid soil sampling and prescription fertilizer maps may result in more accurate recommendations and may lead to greater efficiency in fertilizer use.

Currently the industry standard grid size is 2.5 acres, but Kentucky research shows that variability within areas as small as one acre can be as great as the variability within the entire field. Because soil variability is so high, it is important to treat each grid cell as a field. At least 10 random samples should be collected across the entire grid cell, rather than a few cores from the center of the grid (Figure 3). Grid sampling can be a good way to identify old field boundaries or parts of fields that have had different management in the past if they are unknown to the current producer. This intensive sampling is costly, and limited Kentucky research has not shown a predictable economic benefit when it is compared to the current recommended method of sampling according to soil type, past history, or past management zones.

Sampling after Banded Fertilizer Applications

Care must be taken when sampling no-till fields that have had fertilizer applied in bands rather than broadcast. Phosphorus, potassium, and zinc are immobile in the soil and remain in the concentrated band for several years after application. If these bands are completely avoided during sampling, soil test results will be lower than "actual," leading to over-fertilization. If bands are included too often, soil test results will be higher than "actual," causing an underestimation of fertilizer needs for the crop.

When the location of the bands is known, it is best to sample in the band one time for every 20 cores taken. If the location of the band is unknown, it is best to take pairs of random samples. The first core is completely random, and the second core is taken one-half the band spacing distance in a direction perpendicular to the band direction. For example, if banded fertilizer was applied on 30-inch spacing, the first core would be randomly selected, and the second sample would be taken 15 inches away (perpendicular to the direction of the band). This process would be repeated at least 10 times in a small field and up to 30 times in a larger field. The more cores that are collected, the more closely the sample will represent "actual" field conditions.

Collecting Lawn or Garden Samples

Sample gardens, lawns, and landscaped areas separately. Collect cores randomly from each area. The area to sample for trees includes the soil below the width of the tree. For shrubs, flower beds, and gardens, sample just the soil where the plants are growing. You should sample problem areas and areas with shrubs, trees, or flower beds separately from other turf or lawn areas. **Do not sample:**

- compost areas,
- under the drip-line of trees, and
- close to driveways or streets.

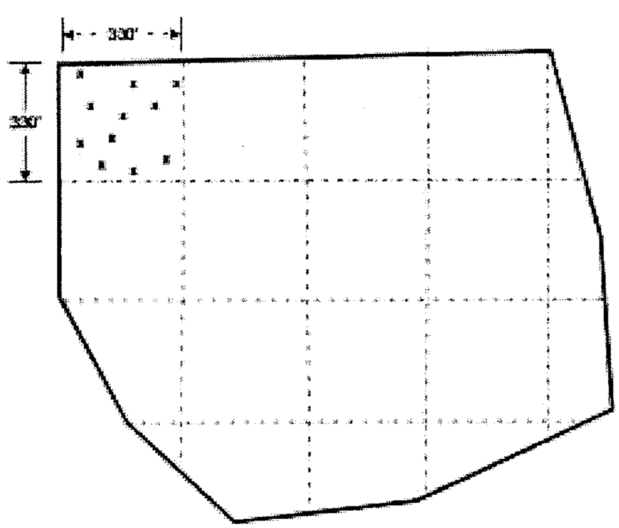

Figure 3. A field can be divided into 2.5-acre grid cells, as shown in the diagram above. Each cell should be treated as an individual field, and approximately 10 random cores should be taken from each cell.

Sample Depth

One commonly overlooked component of soil sampling is the depth of soil to be tested. Most plant nutrients accumulate at the soil surface. This nutrient stratification is a result of past broadcast fertilizer applications and decomposition of plant residue on the soil surface. Because there is a higher concentration of nutrients on the soil surface, soil test values usually go down as the sample depth is increased. To obtain accurate and consistent (between different years) results, samples must be taken to the following depths for these areas:

Tilled Areas—Take soil cores to the depth of the tillage operation (usually 6 to 8 inches).

Non- or Reduced-Tilled Areas—Take soil cores to a depth of 3 to 4 inches for pastures, no-till planting (where fertilizer or lime remains on the soil surface), and minimum-till planting (where fertilizer is incorporated only in the surface 1 to 2 inches).

Lawns and Turfgrasses—Collect soil cores to a depth of 3 to 4 inches.

Sample Preparation

After all cores for an individual sample are collected and placed in the bucket, crush the soil material and mix the sample thoroughly (Figure 4). Allow the sample to air dry in an open space free from contamination. **Do not dry the sample in an oven or at an abnormally high temperature.** When dry, fill the sample container with the soil (Figure 5).

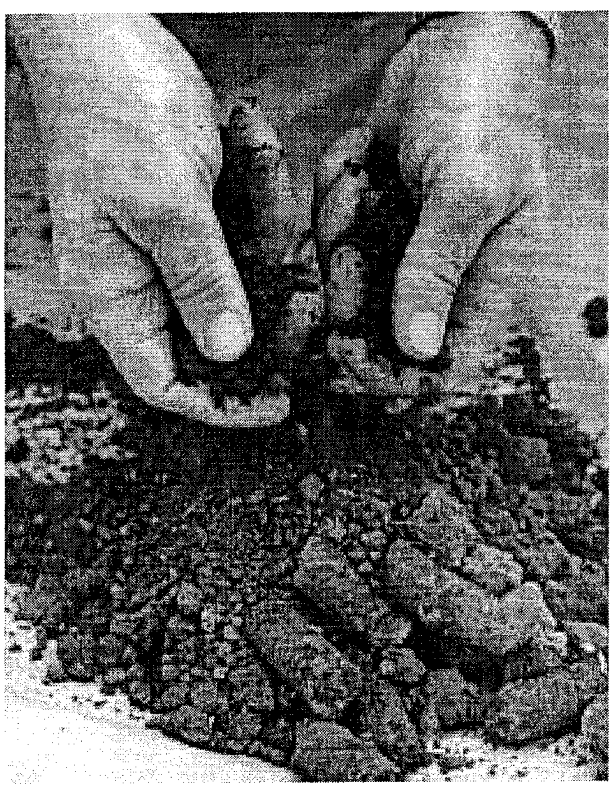

Figure 4. Break up clods while a sample is moist, and spread out to air dry in a clean area.

Sampling and preparing the soil for submission is only half of the process. The other equally important part is filling out a sample information sheet so that the desired crop, tillage, and other information can be considered when making the fertilizer recommendation (Figure 5). The sample information sheet contains all the important information required to provide accurate lime and fertilizer recommendations. Sample information sheets for the University of Kentucky Soil Testing Laboratory can be found on the Web at <http://soils.rs.uky.edu/sample1.htm>. The types of forms available are the:

- agricultural form,
- home lawn and garden form, and
- commercial horticulture form.

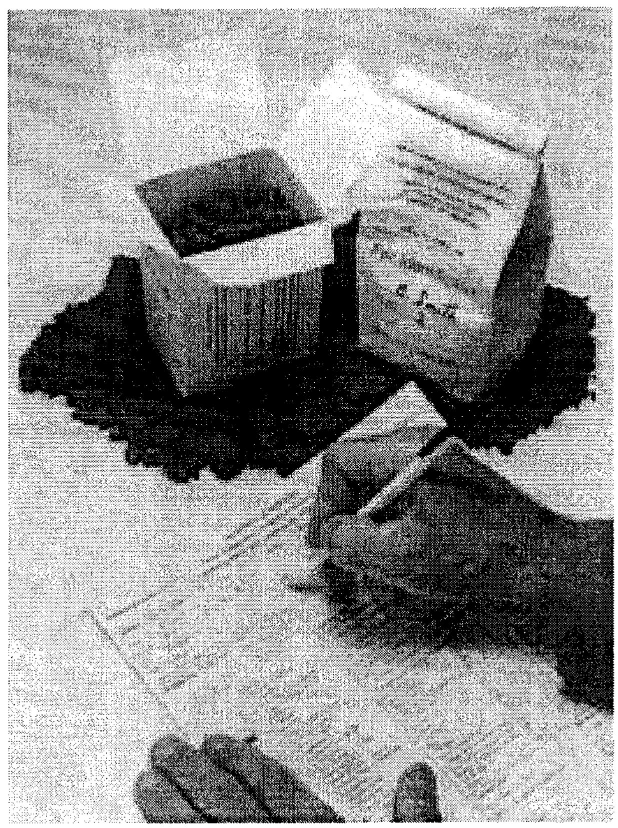

Figure 5. Thoroughly mix the air-dried sample, fill the sample bag or box, mark with your sample designation, fill out the information sheet, and take the sample to your county Extension office.

Each form asks for primary and alternative crops, as well as other background information. The amount of background information needed depends on the crop to be grown. Table 1 is provided as a guide to the background information needed for major agricultural crops (a) and home lawn and garden plants (b). Help on filling out the forms can be provided by your county Extension office.

It is very important to complete the pertinent sections of the sample information form. This will assure that you receive the most accurate fertilizer recommendations possible. Soil samples should be taken to your county Extension office; from there they will be sent to the UK Soil Testing Laboratory. Results and recommendations will be e-mailed to the county office usually within one to two weeks of submission.

Table 1. List of required crop information for accurate lime and fertilizer recommendations.

A. Agricultural Soil Sample Form

	Primary Crop			
Required Information	**Corn**	**Soybeans**	**Tobacco**	**Forages**
Previous crop	yes[1]	no[2]	yes	no
Primary management	yes	no	no	yes
Previous management	yes	no	no	no
Primary use	yes	no	no	yes
Previous use	no	no	no	no
What was there 2 years ago?	no	no	yes	no
Soil drainage	yes	no	yes	no

B. Home Lawn and Garden Soil Sample Form

	Primary Crop		
Required Information	**Vegetables & Fruits**	**Turfgrass**	**Landscape Plants**
Turfgrass location	no[2]	yes[1]	no
General information	no	yes	no

[1] Yes = Information is needed for accurate recommendations.
[2] No = Information is not needed for accurate recommendations.

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Sampling Animal Manure

Richard D. Coffey, Gary R. Parker, and Kevin M. Laurent, Department of Animal Sciences; Doug G. Overhults, Department of Biosystems and Agricultural Engineering

Animal manure is an excellent fertilizer for crops and forages. Manure contains nitrogen, phosphate, potash, and micronutrients that are essential for plant growth. Also, applying manure to land can improve soil tilth, increase water-holding capacity, reduce water and wind erosion, improve aeration, and promote beneficial organisms. Because of these benefits, a majority of manure nutrients produced by Kentucky's livestock and poultry are recycled to the land.

Average manure nutrient content values (book values) provide estimates that can be used for planning purposes. However, manure nutrient concentrations can vary widely among different farms. Factors that influence the nutrient content of manure include animal species, size and number of animals housed, diet composition, feed efficiency, type of manure storage, and manure management factors (frequency of building cleanout, frequency of flushing pits, storage time, amount of water or bedding added to manure, etc.). The unpredictability of nutrient content makes nutrient testing of manure a critical part of a sound manure management plan. This publication provides some guidelines to use when sampling animal manure for laboratory analysis.

When to Sample Animal Manure

To ensure adequate time for a laboratory to complete an analysis and determine manure application rates, you should sample manure within 30 to 60 days of the date you plan to apply it. Nutrient levels in manure storage structures typically do not change rapidly, and an elapsed time of a few weeks between sampling and application is not likely to be critical. Seasonal variations do occur, however, and it is best not to use a manure analysis obtained in the spring for applications in the fall. A manure analysis should be obtained each year.

If it is not possible to obtain an analysis before the manure is applied, you can sample the manure just before or while spreading it. You can use nutrient estimates or historical analysis results to determine an application rate that is not likely to provide an excessive amount of nutrients. Additional nutrients, from manure or chemical fertilizer, can be applied later if the test results show they are needed.

Techniques for Sampling Different Types of Manure

The accuracy of a manure nutrient analysis is only as accurate as the sample sent to the lab. You must collect a sample that is representative of the entire batch of manure being tested. The following sampling techniques for various types of manure will help ensure that you obtain the best possible analysis.

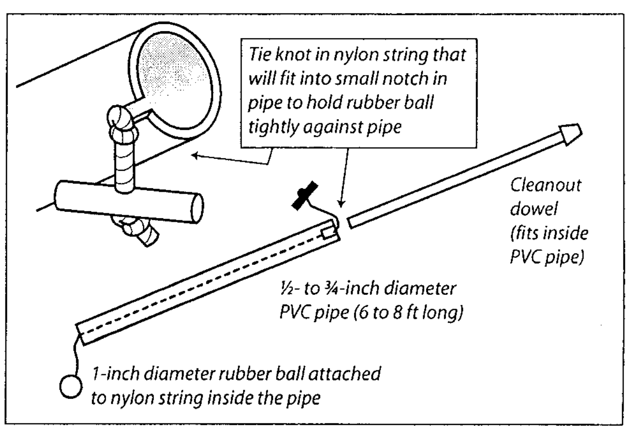
Sampling Manure Slurries from Slotted-Floor Pits

Many swine production facilities use slotted floors over a pit to collect and store manure until application. As manure collects in a pit, solids settle toward the bottom of the pit, and nutrients stratify into layers of varying nutrient content. Because of this stratification, before samples are taken, the pit contents should be mixed (or agitated) for 2 to 4 hours to ensure that a representative sample is obtained. It is very important to use adequate ventilation when agitating slotted-floor pits.

Equipment needed to collect samples from an under-slat pit includes: (1) a composite sampling device such as the one shown in Figure 1, (2) a 5-gallon plastic bucket (do not use galvanized containers because metals in the container such as zinc may contaminate the sample), and (3) a clean, 1-quart, widemouthed plastic bottle with a screw-type lid. NEVER USE A GLASS CONTAINER FOR SAMPLES.

Approximately 10 to 12 subsamples should be taken from different locations throughout the pit. To obtain the subsamples, lower the composite sampling device through the slots until

Figure 1. An example of a composite sampling device for sampling manure from slotted-floor pits.



you feel the bottom of the pit. Then, pull the nylon string running through the interior of the composite sampling device until the rubber ball seals against the bottom of the PVC pipe. Remove the sampling device from the pit, and empty the entire contents into the plastic bucket.

After all subsamples have been collected, swirl or mix the slurry in the bucket, and pour the composite sample into the plastic bottle. Fill the plastic bottle no more than two-thirds full to allow room for expansion caused by the release of gas from the liquid manure sample. Be sure to tighten the lid to prevent the sample from leaking during delivery to the testing lab. Refrigerate or freeze samples that cannot be shipped or delivered to the testing lab on the day of collection.

Sampling Manure Slurries from Earthen Storage Basins (Holding Ponds) and Aboveground Tanks

Manure stored in earthen basins and aboveground tanks is similar to that stored in under-slat pits in that the solids settle and nutrients tend to stratify in storage. Manure in these storage structures should be thoroughly agitated before taking the sample.

The equipment needed to collect samples from storage basins and tanks includes: (1) a composite sampling device such as the one shown in Figure 2, (2) a 5-gallon plastic bucket, and (3) a clean, 1-quart, widemouthed plastic bottle with a screw-type lid.

About 10 to 12 subsamples from different locations around the basin or tank should be collected. To collect subsamples, lower the full length of the composite sampling device (or to within the bottom foot of the storage structure) into the manure slurry, and then pull the nylon string attached to the rubber ball to seal the slurry within the sampling device. Remove the sampling device, and empty the contents into the 5-gallon bucket. After all subsamples have been collected in the bucket, thoroughly mix the slurry in the bucket. Fill the plastic bottle no more than two-thirds full with the composite sample. Securely tighten the lid on the bottle to prevent the sample from leaking.

Sampling Manure Effluent from Lagoons

The nutrient content of lagoon effluent may vary from the top layer to the bottom layer. Obtaining a representative sample from lagoons is difficult and requires collecting subsamples to the depth from which the effluent will be applied. For example, if effluent is pumped only from the top layer of the lagoon without any agitation, you need to sample only from that portion that is to be pumped. If a lagoon will be agitated when it is pumped, it is best to sample from the fully mixed lagoon or to take several subsamples on the discharge side of the pump. Producers with multistage systems should collect samples from the lagoon that will be pumped for land application. Two methods that can be used to sample lagoon effluent—the pole and cup method and the composite (or profile) method—are described below.

Figure 2. An example of a composite sampling device for sampling manure from earthen basins and aboveground tanks.

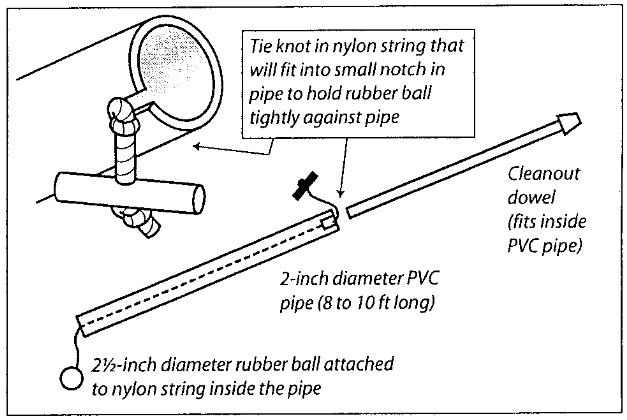
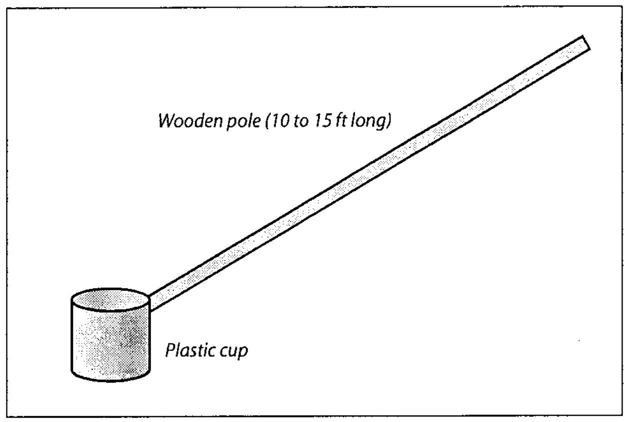


Figure 3. An example of a pole and cup sampling device for sampling manure effluent from lagoons.



Pole and Cup Method

The equipment needed to sample lagoons using the pole and cup method includes: (1) a pole and cup liquid manure sampling device such as the one shown in Figure 3, (2) a 5-gallon plastic bucket, and (3) a clean, 1-quart, widemouthed plastic bottle with a screw-type lid.

Using the pole and cup sampling device, collect 10 to 12 subsamples by extending the sampling device the length of the pole toward the center of the lagoon, and dip a cupful of lagoon effluent. Do not collect solids, floating debris, or scum with the subsample. Each of the subsamples should be taken from different locations around the lagoon. As each subsample is collected, pour the contents into the 5-gallon plastic bucket. After all subsamples have been collected, thoroughly mix the contents in the bucket. Fill the plastic bottle about two-thirds full with the composite sample. Securely tighten the lid to prevent the sample from leaking.

Composite (or profile) method

The composite (or profile) method of sampling allows subsamples to be taken from the full depth of the lagoon. The equipment needed for this sampling method includes: (1) a composite sampling device such as the one shown in Figure 4, (2) a 5-gallon plastic bucket, and (3) a clean, 1-quart, widemouthed plastic bottle with a screw-type lid.

Approximately 10 to 12 subsamples taken from different spots in the lagoon are needed to obtain a representative sample. Ideally, a small boat that could be paddled into the lagoon would be used to collect samples away from the edges. To collect subsamples, lower the full length of the composite sampling device into the lagoon, or lower the device until it reaches the bottom of the lagoon (be careful not to plug the end of the sampling device with sludge at the bottom of the lagoon). Then, pull the nylon string running through the interior of the composite sampling device until the rubber ball seals against the bottom of the PVC pipe. Remove the sampling device from the lagoon, and empty the entire contents into the plastic bucket.

After all subsamples have been collected in the bucket, thoroughly swirl or mix the effluent. Fill the plastic bottle no more than two-thirds full with the composite sample. Securely fit the lid on the bottle to prevent the sample from leaking.

Sampling Dry Manure Stacks or Litter Piles

Solid (dry) manure and poultry litter is often stored outside in a stack pad, horizontal concrete silo located above ground, or litter storage shed. Collecting a representative sample from these types of storage structures requires: (1) a shovel or solid manure sampling device such as the one shown in Figure 5, (2) a wheelbarrow, (3) a 5-gallon plastic bucket, and (4) a 1-quart plastic freezer bag.

Identify 10 to 12 widely dispersed points on the manure stack or litter pile that represent the average moisture content of the manure. The sampling points should include the center of the stack or pile as well as some near the edges. From each of these points, remove the top crust layer, collect 3 to 5 subsamples with the shovel or solid manure sampling device, and place the collected litter or manure in the wheelbarrow. Thoroughly mix and crumble the collected subsamples, and place one shovelful in the plastic bucket. Repeat this process from each of the collection points. After collecting subsamples from each point, crumble and thoroughly mix all of the subsamples in the bucket. Fill the freezer bag two-thirds full (do not completely fill) with the composite sample, compress the air from the bag, and seal the bag. It is a good practice to tape over the seal to ensure that the bag does not come open during transit to the testing lab.

A key factor in obtaining a good sample from solid manure and litter storage facilities is to collect multiple subsamples from throughout the stack or pile at a time when the nutrient content is fairly stable. Unless the manure or litter is to be spread within the next few days, samples should not be collected from a freshly loaded or turned manure stack or litter pile. The nutrient content should stabilize within about two weeks of forming a new pile or turning an existing pile.

Sampling Dry or Solid Manure from Paved Lots

In certain livestock production systems, animals are housed on paved feedlots where the manure that accumulates is scraped and hauled to the field (the "scrape-and-haul" method of manure utilization). The manure is typically removed from the paved area daily or several times each week. Equipment needed for collecting manure samples from paved lots includes: (1) a shovel, (2) a wheelbarrow, and (3) a 1-quart plastic freezer bag.

Approximately 10 to 12 subsamples should be collected from the paved lot. When identifying the areas of the paved lot to sample, be sure to choose areas that best represent the proportion of any variable conditions you observe, such as variations in moisture content, amount of bedding, etc. Each subsample should be collected by scraping the shovel across about 25 feet of the paved lot. After scraping across the paved lot, place the manure on the shovel in the wheelbarrow. Once all subsamples have been placed in the wheelbarrow, use the shovel to thoroughly mix and crumble the manure. Then, fill the freezer bag approximately two-thirds full with the composite sample. Compress any air remaining in the bag before sealing it.

Figure 4. An example of a composite sampling device for sampling manure effluent from lagoons.

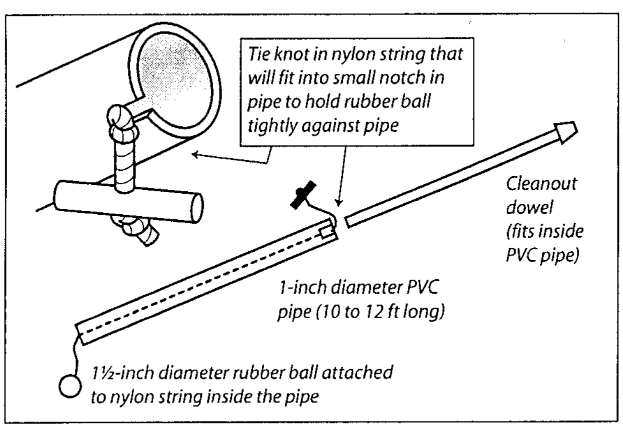
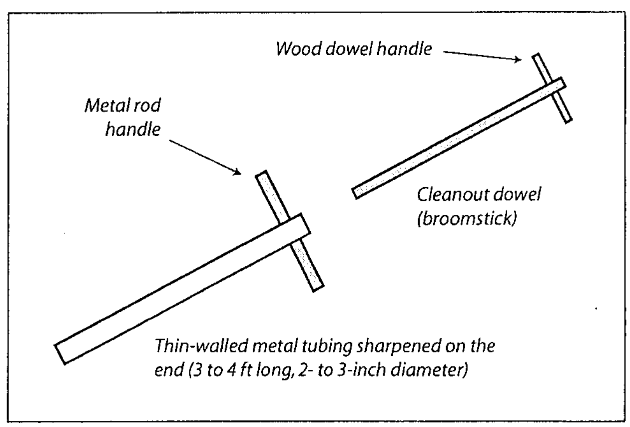


Figure 5. An example of a solid manure sampling device for sampling manure from dry manure stacks or litter piles.



Sampling Poultry Litter before Full Cleanout

The point method and trench method are two options suitable for sampling poultry litter in the house. The objective of both methods is to obtain a sample that is representative of the litter within the entire house. Obtaining an adequate sample may take more than 30 minutes. Although this may seem an excessive amount of time, it is necessary to follow the proper procedures to ensure usable results.

Point method

Equipment needed to sample litter using the point method includes: (1) a 5-gallon plastic bucket, (2) a narrow, square-ended spade or a solid manure sampling device (Figure 5), and (3) a 1-quart plastic freezer bag.

The first step in the point method is to visually divide the house into three zones. For example, if the house runs in the north-south direction, divide the house into east, middle, and west zones (Figure 6). Walk the length of the building within a zone in a zigzag pattern and take 8 to 10 random subsamples with the spade (or solid manure sampling device) along your path. When taking each subsample, clear a small trench the width of the spade to a depth just above the dirt floor. Then take a 1-inch slice as the subsample, being sure to get equal amounts of litter the entire depth of the trench (Figure 7). Be sure to take a representative number of subsamples under feeders and waterers. Place each of the subsamples into the plastic bucket. This process should be repeated in each of the three zones.

Once subsamples have been collected from each zone, thoroughly mix and crumble all of the litter in the bucket. It may be necessary to pour the litter into a wheelbarrow or onto a piece of plywood to facilitate mixing. After thoroughly mixing, fill the freezer bag about two-thirds full with the composite sample. Be sure to compress the air from the bag before sealing it.

Figure 6. An example of zone identifications and sampling patterns for the point method.

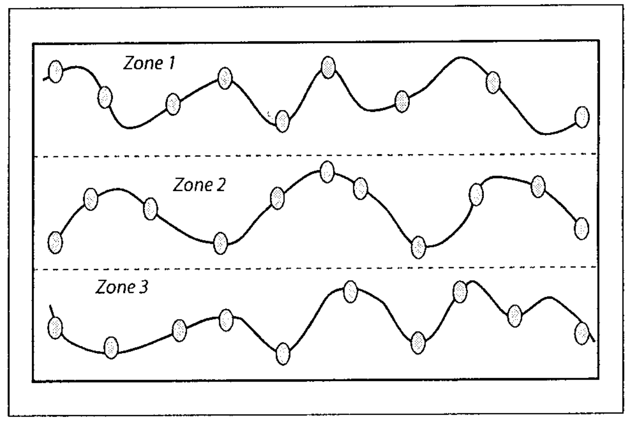
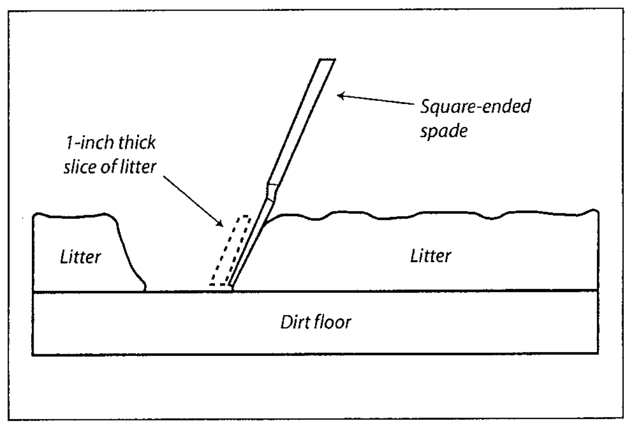


Figure 7. For the point method, use a square-ended spade to dig a small trench and take a subsample.



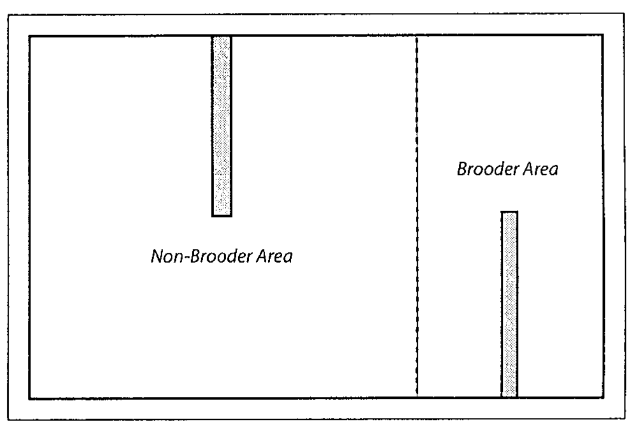
Trench method

Equipment needed to sample litter using the trench method includes: (1) a narrow, square-ended spade, (2) a wheelbarrow, (3) a 5-gallon plastic bucket, and (4) a 1-quart plastic freezer bag.

With the trench method, the building is divided into two areas—the brooder portion of the house and the non-brooder portion of the house (Figure 8). In approximately the middle of the brooder area, dig a trench the width of the spade from the centerline of the house to the sidewall. The trench should extend down through the litter to just above the dirt floor. Place all litter removed from the trench into the wheelbarrow. Repeat this process in the non-brooder portion of the house.

Depending on the width of the house and the depth of the trench, the amount of collected litter may exceed the capacity of the wheelbarrow. If this is the case, each time the wheelbarrow is two-thirds full, thoroughly mix and crumble the litter from the trenches. After mixing, remove one shovelful of litter and place it in the 5-gallon bucket. Empty the remainder of the litter from the wheelbarrow near the side of the trench. Repeat this process until both trenches have been completed. Then, thoroughly mix the litter collected in the bucket. Fill the freezer bag about two-thirds full with the composite sample, taking care to compress the air from the bag before sealing it.

Figure 8. An example of zone identifications and sampling patterns for the trench method.



Sampling Poultry Litter during Full Cleanout

Equipment that will be needed to sample poultry litter when the entire house is being cleaned out includes: (1) a shovel, (2) a wheelbarrow, (3) a 5-gallon plastic bucket, and (4) a 1-quart plastic freezer bag.

Take one shovelful of litter from each truckload of litter removed and place it in the wheelbarrow. Depending on the volume of litter being removed, the amount of collected litter may exceed the capacity of the wheelbarrow. If this occurs, each time the wheelbarrow is two-thirds full, thoroughly mix the contents of the wheelbarrow and place one shovelful of litter in the 5-gallon bucket. Repeat this process until each truckload of litter has been sampled. Then, thoroughly crumble and mix the litter in the bucket. Fill the freezer bag about two-thirds full with the composite sample. Compress the air from the freezer bag before sealing it.

Either the point method or the trench method can also be used to sample litter from the house immediately before cleaning it out.

Handling and Labeling Manure Samples

Ideally, manure samples should be mailed or delivered to the laboratory the day they are collected. If manure samples must be held longer than 24 hours, refrigerate or freeze the samples until they can be shipped to the testing lab. Do not let manure samples sit in hot areas such as the dashboard or trunk of a vehicle. If manure samples cannot be hand delivered to the testing lab, they should be mailed or shipped early in the week (Monday through Wednesday) to avoid arrivals on the weekend. Also, avoid shipping near holidays that could delay delivery.

All samples sent to the testing lab should be clearly labeled with a permanent marker. Include on the label the owner's or operation's name and address, sample identification number, date sample collected, and type of manure.

Where to Send Manure Samples for Analysis

The Soil Testing Lab at the University of Kentucky Regulatory Services provides an analysis of animal manures that includes these factors:

- moisture (for solid manures)
- total nitrogen (N)
- phosphorus (reported as P_2O_5)
- potassium (reported as K_2O)
- calcium (Ca)
- magnesium (Mg)
- copper (Cu)
- zinc (Zn)
- iron (Fe), and
- manganese (Mn).

Nutrient concentrations are reported as pounds per ton for solid manures and as pounds per 1,000 gallons for liquid manures. The cost of the analysis is $20.

To obtain an analysis from UK Regulatory Services, take manure samples to the local county Extension office. These offices have plastic bottles for liquid manure samples and an information sheet (also included in this publication) to fill out for the sample being submitted. The Extension office will send the sample to:

UK Regulatory Services
Attention: Soil Lab
103 Regulatory Services Building
Alumni and Shawneetown Roads
University of Kentucky
Lexington, KY 40546-0275

Local county Extension agricultural agents can provide assistance with manure sampling, interpreting analysis results, and determining application rates. Two Extension resources — the Manure Management Planner Spreadsheet, a Microsoft® Excel-based computer program, and AGR-146, *Using Animal Manures as Nutrient Sources*—are available at local county Extension offices for calculating manure application rates based on manure analysis results and soil test recommendations.

Table 1 shows a partial listing of commercial laboratories that are also available for conducting analyses on manure samples. These labs can usually provide a detailed analysis of manure, including the different forms of nitrogen and most trace elements.

Conversion Information for Manure Test Results

Because different labs report results in different ways, the following conversion chart may be helpful in interpreting individual results.

P (elemental phosphorus) x 2.27	=	P_2O_5 (phosphate)
K (elemental potassium) x 1.2	=	K_2O (potash)
percent (%) x 20	=	pounds per ton
percent (%) x 80	=	pounds per 1,000 gallons
percent (%) x 2,254	=	pounds per acre-inch
mg/L (milligrams per liter) x 0.002	=	pounds per ton
mg/L (milligrams per liter) x 0.008	=	pounds per 1,000 gallons
mg/L (milligrams per liter) x 0.225	=	pounds per acre-inch
pounds per ton x 4.17	=	pounds per 1,000 gallons
pounds per 1,000 gallons x 0.2398	=	pounds per ton
1 gallon	=	8.34 pounds
1 acre-inch	=	27,154 gallons
mg/L (milligrams per liter)	=	ppm (parts per million)

Table 1. Commercial Animal Manure Testing Laboratories[a]

Laboratory	**Types of Analyses**[bc]
A&L Analytical Laboratories, Inc. 411 North 3rd Street Memphis, TN 38105 Phone: (901) 526-1031 Web site: www.al-labs.com	(1) Basic M1 analysis – moisture, total N, P_2O_5, K_2O (2) Basic M2 analysis – moisture, total N, P_2O_5, K_2O, Ca, Mg, Na, S, Fe, Al, Mn, Cu, Zn
Chemical Services Lab 3303 Industrial Parkway Jeffersonville, IN 47130 Phone: (812) 280-1090	(1) NPK analysis – total N, P_2O_5, K_2O (2) NPK analysis plus trace elements – total N, P_2O_5, K_2O, Ca, Mg, Fe, Mn, Cu, Zn, SO_4
Holmes Laboratory, Inc. 3559 U.S. Rt. 62 Millersburg, OH 44654 Phone: (330) 893-2933 Web site: www.holmeslab.com	(1) Test K – total solids, moisture, pH, total N, ammonium N (NH_4), P_2O_5, K_2O, Ca, P, Mg, K (2) Test M – total solids, moisture, pH, total N, ammonium N (NH_4), P_2O_5, K_2O, Ca, P, Mg, K, Na, Cu, Mn, Zn, Fe
Iowa Testing Laboratories, Inc. Highway 17 North P.O. Box 188 Eagle Grove, IA 50533 Phone: (515) 448-4741 Web site: www.swine.net/itl.htm	(1) Standard analysis – moisture, total N, P_2O_5, K_2O (2) Analysis of trace elements – Ca, P, K, Mg, S, Zn, Mn, Cu, Fe, Co, Na (3) Complete analysis – moisture, total N, P_2O_5, K_2O, Ca, Mg, S, Zn, Mn, Cu, Fe, Co, Na
Spectrum Analytic, Inc. P.O. Box 639 1087 Jamison, Road Washington Courthouse, OH 43160 Phone: (800) 321-1562 Web site: www.spectrumanalytic.com	(1) NPK analysis – total N, P_2O_5, K_2O, moisture/DM (2) Complete analysis - total N, ammonium N (NH_4), nitrate N (NO_3), total P_2O_5, available P_2O_5, K_2O, pH, moisture/dry matter, Ca, Mg, S, B, Cl, Cu, Fe, Mn, Zn, Al, As, Ba, Cd, Cr, Co, Pb, Hg, Mo, Ni, Se, Si, Ag

It is recognized that this is not an all-inclusive list of commercial laboratories. Neither endorsement of companies or their services mentioned is intended, nor is criticism implied of similar companies or their services not mentioned.

[a] Many commercial laboratories will provide sample containers for manure samples that are being sent to their labs. Contact the specific commercial testing lab to learn if sample containers are available.

[b] The cost of manure analyses will vary among commercial laboratories. However, most basic manure analyses (total N, P_2O_5, and K_2O) will typically range from approximately \$20 to \$40, and more complex analyses (additional forms of N and more complete analysis of trace elements) will usually range from approximately \$40 to \$75. Contact the specific testing lab for a current schedule of fees.

[c] Many of the commercial laboratories mentioned conduct additional analyses that are not listed here (such as ammonium N, nitrate N, carbon:nitrogen ratio, organic matter, solids, electrical conductivity, etc.). Contact the specific testing lab of interest for a more complete listing of available analyses.

UNIVERSITY OF KENTUCKY

College of Agriculture Cooperative Extension Service

AGRICULTURAL ANIMAL MANURE SAMPLE INFORMATION SHEET

Department of Agronomy

Division of Regulatory Services

Section I. Owner Information

DATE SAMPLED: _____/_____/_____

NAME: ______________________________

ADDRESS: ______________________________

CITY: ________________ STATE: _____ ZIP: _____

PHONE: ______________________________

Owner's Sample ID:

Section II. Test to be Made

☐ Routine (Total N, P_2O_5, K_2O, and moisture for solids)

Section VI. Lab Use

Section VII. County

County Code

County Sample No.

Section III. Type of Animal Manure

_____ Poultry

_____ Dairy

_____ Swine

_____ Beef

_____ Solid

_____ Liquid

Section VIII. Lab Use Only

Billing Code ____________

Section IV. Animal Waste Application History

Section V. Other Information

Paid ________

____

Signature of Extension Agent

AGR-1

COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY—COLLEGE OF AGRICULTURE

2006-2007 Lime and Nutrient Recommendations

Contents

Basis of Nutrient Recommendations

Additions of a recommended nutrient are based on a soil test only when a crop yield or economic response has been measured for that crop under Kentucky soil-climatic conditions. Many field studies have been conducted by the Kentucky Agricultural Experiment Station under Kentucky farm conditions to determine the extent of any primary, secondary, or micronutrient needs. Yield and soil test data from these studies serve as guidelines for establishing recommendations contained in this publication.

Nutrient recommendations in this publication are based on soil test values obtained using testing methods in the laboratories operated as part of the Kentucky Agricultural Experiment Station. This laboratory uses the Mehlich III solution to extract phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and zinc (Zn). Water pH is determined in a 1:1 (v/v) ratio of deionized water:soil, and buffer pH is determined with the Sikora buffer (Soil Science Society of America Journal 70, 2006). These methods are described in Bulletin 190 of the Southern Cooperative Series (November 1984), Procedures Used by the State Soil Testing Laboratories in the Southern Region of the United States. The nutrient recommendations in this publication should not be used for soil test results obtained by other testing methods.

The recommendations are based on assumed average climatic and management conditions for Kentucky. Rates should be adjusted upward or downward to reflect any deviations from these assumptions.

The rates recommended are for production of a crop to be grown each year and will increase soil test values slowly for P and K. Using these recommended rates would likely take four years or longer of annual nutrient application at the recommended rates to result in appreciably higher soil test levels of P and K.

CEC and Percent Base Saturation

Values for cation exchange capacity (CEC) and percent base saturation (% BS) are reported for all soil samples analyzed routinely in the University of Kentucky Soil Testing Laboratories. The CEC is an estimate that is calculated according to accepted practices, with a modification to better reflect specific Kentucky conditions.

Reported values for CEC include an estimation of acidity (expressed as hydrogen, H) reflected by the buffer pH measurement and extractable calcium (Ca), magnesium (Mg), and potassium (K) by the Mehlich III extracting procedure. The total CEC is the sum of milliequivalents per 100 grams of soil (me./100 g) of the following cations: H, Ca, Mg, and K. Values for % BS are the sum of the me./100 g of the basic cations (Ca, Mg, and K) expressed as a percentage of the total CEC. The dominant cation in most Kentucky soils with pH above 5.8 is calcium (Ca), and below pH level 5.8 is hydrogen (H). Rarely does the amount of magnesium (Mg) or potassium (K) greatly affect CEC estimation or % BS. The measurements for Ca and H are the dominant values for estimating both CEC and % BS.

While CEC is not used directly in making nutrient recommendations for agronomic crops, this information does affect lime recommendations. The buffer pH is directly related to the acidity or H fraction of the CEC. Values for % BS are good indicators of the relative presence of the basic cations in the soil. Soils with a 70% BS or greater are unlikely to limit agronomic crop growth due to acidity. Agronomic crop yields on soils with a % BS below 50 can be affected by excessive acidity. Other Extension publications or your county Cooperative Extension Service agent should be consulted for soil pH of specific horticultural or agronomic crops for optimal growth and yield.

Sample Accuracy

It is important that the submitted soil sample accurately represent the field or area from which it was taken, in order to get reliable recommendations. Analytical results provided on the soil test report form are for the sample submitted, and the listed recommendations are based on those results. All recommendations are made on the assumption that a representative soil sample was properly taken. If soil sampling procedures are questionable, accurate nutrient and lime recommendations for the sampled field or area cannot be assured.

Sampling Depth and Frequency

For tilled areas, take soil cores to a depth of 6 to 7 inches. With pastures, lawns, no-tilled areas, and turf, take soil cores to a depth of 3 to 4 inches. Each production field should be sampled every three to four years. Annual sampling is preferable for high-value crops, alfalfa, and double-crop silage. Sampling each year after manure application is recommended. See Cooperative Extension Service publication *Taking Soil Test Samples* (AGR-16) for details.

Plant Analysis

A plant analysis may be used to verify a suspected nutrient problem or to evaluate the nutrient status of a crop. Plant analysis is not a substitute for a soil test but should be used along with a soil test. Your county Extension agent has information on plant analysis services available for various crops.

Fertilizer Banding

If soil tests for phosphorus and potassium are low, one-third to one-half the amount recommended for corn can be used if it is banded 2 to 4 inches from the row.

Soil Drainage Classes and Nitrogen Fertilization

Nitrogen fertilizer recommendations are related to soil drainage differences. Soils differ in water amounts entering and the percolation rate through the root zone. The list of important soil series in Table 1 and their grouping into drainage classes do not always coincide with the NRCS/USDA drainage classes (indicated by an asterisk).

Table 1. Soil drainage classes.

Well-Drained Soils	Allegheny Ashton Baxter Caneyville Crider Cuba Elk Frederick Hagerstown	Huntington Jefferson Loradale Maury McAfee Memphis Nolin Pembroke Pope	Shelbyville Shelocta Trimble Uniontown Vicksburg Wellston Wheeling Whitley
Moderately Well-Drained Soils	Beasley* Bedford Captina Collins Commerce Cotaco	Eden* Grenada Heitt* Loring Lowell* Mercer Morehead	Mountview Nicholson Otwell Sadler Tilsit Zanesville
Somewhat Poorly and Poorly Drained Soils	Belknap Bonnie Calloway Falaya	Henry Johnsburg McGary Melvin	Newark Stendal Tyler Weinbach

* NRCS/USDA drainage classes for these soils are different than above.

Soils with Naturally High Contents of P and K

Some soils naturally contain higher levels of P and K, thus having the ability to supply higher amounts for crop production. Soils developed from phosphatic limestones are likely to maintain high soil test P levels even without fertilization. Also, some soils will contain quite high native K levels.

Recommendations for Soil Samples Testing High

When soil test levels for P and K are so high that no nutrient recommendation is made for the current year, there is no assurance that these high levels will be maintained for optimal production in the following years. When soil test levels are in the upper one-half of the medium range or higher, the area should be sampled again the following year.

Nutrient Recommendations without Soil Tests

If nutrient recommendations must be made without soil test results, assume low levels of residual N, P, and K.

Nutrient Recommendations for Multiple Years

If one nutrient recommendation is made for two years of sequential crops, the recommended rates of phosphate and potash for each crop are added together and applied to the first crop grown. However, this method is not recommended for crops with a high nutrient demand, e.g., alfalfa, corn for silage, tobacco, etc. Double cropping recommendations for small grains and soybean can be found in the "Small Grains" and "Soybean" sections.

Surface Mine Reclamation

See the following Kentucky Cooperative Extension Service publications:

- *Lime and Fertilizer Recommendations for Reclamation of Surface-Mined Coal Spoils* (AGR-40),
- *Sampling Surface Mine Lands before and after Mining* (AGR-41), and
- *Preparation of Surface-Mined Coal Spoils and Establishment of Vegetative Cover* (AGR-89).

Elemental and Oxide Values for P and K

Soil test values for phosphorus and potassium are reported as pounds per acre (lb/A) of elemental P and K. Nutrient recommendations are made on the oxide basis: lb. phosphate (P_2O_5) or potash (K_2O) per acre. Use the factors in Table 2 in converting.

Table 2. Converting elemental and oxide values.

To Convert From:	To:	Multiply By:
P_2O_5	P	0.44
P	P_2O_5	2.29
K_2O	K	0.83
K	K_2O	1.20

Nutrient Value of Manures and Tobacco Stalks

Animal manure and tobacco stalks add nutrients when applied to soils. These should be considered when deciding on materials to use in fulfilling crop nutrient recommendations. The best method to determine content of these materials is through sampling and testing. In cases where it is not possible to take samples in a timely manner, Table 3 can serve as a guide to estimate nutrients contained in the materials listed until samples can be obtained and tested.

It is important to remember when applying organic materials to soil that the nutrients they contain are not as available to the next crop as those nutrients contained in commercial fertilizers. While almost 100% of the potash is available, only about 80% of the phosphate is expected to be available to the next crop. Nitrogen availability is more variable, with its availability dependent on livestock species, how it is stored and handled, and when and how it is applied.

Animal manures also contain significant amounts of calcium, magnesium, sulfur, zinc, copper, and molybdenum that may be of value to crops. The added organic matter can also be of significant benefit to soils low in organic matter.

Extension publication *Using Animal Manures as Nutrient Sources* (AGR-146) and a computer spreadsheet (http://soils.rs.uky.edu/manureprogram.htm) are available to help determine application rates and fertilizer credits. Additional assistance can be obtained at your county Cooperative Extension Service office.

Tobacco stalks that are under a cover to prevent leaching of nutrients by rainfall are a significant source of nutrients. See Extension publication *Tobacco Stalks and Stems Fertility Value and Use* (AGR-23) for more information on the storage and use of tobacco stalks.

Table 3. Typical total nitrogen, phosphate, and potash content (lbs of nutrient per ton) of some manures and tobacco stalks.

		Lbs/T		
Animal Manures*	**Water (%)**	**N****	P_2O_5	K_2O
Dairy cattle	80	11	9	12
Swine	80	9	9	8
Beef	80	11	7	10
Broiler litter	20	55	55	45
Broiler layers	40	35	55	30
Broiler pullets	30	40	45	40
Tobacco stalks	0	30	10	70

* Animal manures contain chloride, which can reduce the quality of tobacco. Limit rates to 10 tons per acre of cattle or swine manure. Poultry manure should not be applied to land in the year in which tobacco will be grown.

** Plant available N can range from 20 to 80% of the total N in the year of application. Please see AGR-146, *Using Animal Manures as Nutrient Sources* for more details.

Secondary Nutrients and Micronutrients

Magnesium

Magnesium levels in soils range from very high (in loess-derived soils) to low (some sandstone-derived soils). Only limited crop yield responses have been observed for magnesium fertilization. It is sufficiently important in some areas and in determining CEC that a soil test be offered. Magnesium needs for animals can best be met by direct feeding in the ration rather than through high application rates to soil. Table 4 shows soil test levels and recommended rates for magnesium.

Table 4. Recommendations for magnesium.

Soil Test Level	Lb Mg/A*	Oz Mg/100 Sq Ft**
0 - 6	50	2
7 - 18	45	2
19 - 30	40	2
31 - 42	35	1
43 - 54	30	1
55 - 60	25	1
Above 60	0	0

* These rates may be applied when no lime is needed or where dolomitic lime is not available. When lime is needed, the addition of dolomitic lime is preferred.

** Epsom salts ($MgSO_4.7H_2O$, 10% Mg) is readily available and may be more convenient for applying Mg to small areas.

Iron, Copper, Sulfur, Boron, and Molybdenum

We have neither measured any response to nor observed indications of needs for additional iron, copper, or sulfur. Yield responses to boron and molybdenum have been observed for certain crops under certain conditions. Boron is recommended for topdressing on alfalfa. Consult the sections on tobacco, soybean, alfalfa, and pasture renovation with legumes for molybdenum recommendations.

Zinc and Manganese

Yield responses to zinc applications on corn and to foliar applications of manganese on soybean have been observed in Kentucky. The responses to manganese on soybean have been on a few soils in Daviess, McLean, and Webster counties. After diagnosis of manganese deficiency, responses to foliar applications have been superior to soil-applied manganese at planting. To date, soil testing has not been advantageous in solving any isolated cases in Kentucky soils.

Zinc deficiency in corn is significant in Central and South-Central Kentucky. A soil test for zinc is performed routinely on all samples submitted to the UK Soil Testing Lab. The zinc test results and soil test results for P and soil pH are used in identifying soils that need zinc applications.

Nutrients Removed by Agronomic Crops

Good nutrient management involves effective use of applied nutrients at rates utilized by crops. As a basis to assess long-term soil fertility trends, some may use crop nutrient removal while others may use crop uptake. Crop nutrient removal is the quantity of nutrients removed from a field in the harvested portion of the crop. This should not be confused with crop nutrient uptake values, which are the total amount of nutrients taken up by the entire crop (roots, stems, leaves, and seed) in a field. For quick reference, Table 5 includes crop nutrient removal values, published in Extension publication Assessment of the Potential for Livestock and Poultry Manure to Provide the Nutrients Removed by Crops and Forages in Kentucky (IP-56) and in "NRCS Nutrient Management Standard Code 590."

Table 5. Crop nutrient removal values.

Crop	Yield Unit	Nutrients Removed N	P_2O_5	K_2O
from IP-56:		**Lb/Yield Unit**		
Alfalfa hay	ton	50.00	14.000	55.000
Grass/legume hay	ton	35.00	12.000	53.000
Fescue hay	ton	35.00	18.00	50.00
Pasture forage	ton	10.50	3.600	15.900
Corn for grain	bu	0.70	0.400	0.350
Silage corn	ton	7.50	3.500	8.000
Wheat grain	bu	1.20	0.500	0.300
Wheat straw	ton	12	4.00	20.00
Sorghum grain	bu	0.95	0.410	0.300
Soybean grain	bu	3.00	0.700	1.100
Burley tobacco	lb	0.07	0.011	0.075
Dark air tobacco	lb	0.07	0.006	0.060
Dark fired tobacco	lb	0.07	0.006	0.060
Barley grain	bu	0.90	0.410	0.300
Crop	**Yield Unit**	**Nutrients Removed N**	**P_2O_5**	**K_2O**
from NRCS Code 590:		**Lb/Yield Unit**		
Rye grain	bu	1.16	0.330	0.320
Oats grain	bu	0.62	0.250	0.190
Bermuda grass hay	ton	37.60	8.700	33.600
Reed canary hay	ton	27.00	8.200	25.000
Eastern gamma hay	ton	35.00	16.100	31.200
Other warm-season hay	ton	20.00	6.800	25.000

Soil Buffer Test

The pH of the soil is a measurement made from a mixture of soil and water and is reported for all samples. The soil buffer test is performed and used to determine lime requirement of samples with a soil pH of 6.4 or below. In the soil buffer test, a buffer solution is mixed with soil, and the pH of the mixed solution is measured. The result from the buffer test is reported as buffer pH. The buffer pH and the soil pH together can be used to determine lime requirement for changing soil pH to some desired level. The University of Kentucky soil test laboratories started using the Sikora buffer in 2005, replacing the SMP buffer which contained hazardous chemicals such as chromium and p-nitrophenol. The Sikora buffer provides the same buffer pH as SMP buffer so changes in agronomic interpretation of the data was not required.

To determine how much lime is required to raise soil-water pH, see the table with your target pH in the heading. Tables 6, 7, and 8 show target soil-water pH of 6.4, 6.6, and 6.8, respectively. Amounts of limestone per acre are given for water pH vs. buffer pH in increments of 0.2 pH units. (Computerized recommendations use 0.1 pH unit increments.) To determine limestone rates, read down the left side of the appropriate table to the water pH reading, then read across to the column under the buffer pH reading. If hydrated lime is applied, use two-thirds of the rate shown.

The adjustment of soil pH by limestone is affected by (1) thoroughness of mixing into the soil; (2) depth of mixing into soil (top 6 inches is assumed); (3) time of reaction (four years are needed for complete reaction of limestone; however, the reaction time for hydrated lime is much shorter); (4) quality of limestone (a relative neutralizing value of 67% is assumed); and (5) use of acid-forming nitrogen fertilizers that can lower the effective soil pH obtained. When applying lime rates greater than 4 tons per acre (T/A), the lime should be thoroughly mixed in the plow layer by applying one-half the recommended rate before plowing and the other half after plowing followed by discing. Consult Determining the Quality of Aglime: Relative Neutralizing Value (RNV) (AGR-106) and your county Extension agent for lime quality information in your area. Adjusting lime applications based on relative neutralizing values other than 67% and comparing economic values of various lime sources in the state can be done with calculators on the internet at http://soils.rs.uky.edu/calculators.php3.

Table 6. Rate of 67% RNV agricultural limestone (T/A) needed to raise soil pH to 6.4.

Water pH of Sample	Buffer pH of Sample 5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	If Buffer pH is Unknown
4.5	7.0	6.0	6.0	5.0	4.0	4.0	3.0	3.0	4.0
4.7	7.0	6.0	6.0	5.0	4.0	4.0	3.0	3.0	4.0
4.9	7.0	6.0	6.0	5.0	4.0	4.0	3.0	3.0	4.0
5.1	7.0	6.0	5.0	5.0	4.0	3.0	3.0	2.0	4.0
5.3	7.0	6.0	5.0	4.0	4.0	3.0	3.0	2.0	3.5
5.5	6.0	5.0	5.0	4.0	4.0	3.0	2.0	2.0	3.0
5.7	6.0	5.0	4.0	4.0	3.0	3.0	2.0	2.0	2.5
5.9	—	5.0	4.0	3.0	3.0	2.0	2.0	1.0	2.0
6.1	—	—	3.0	3.0	2.0	2.0	1.0	1.0	1.5

Table 7. Rate of 67% RNV agricultural limestone (T/A) needed to raise soil pH to 6.6.

Water pH of Sample	Buffer pH of Sample 5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	If Buffer pH is Unknown
4.5	7.0	7.0	6.0	6.0	5.0	4.0	4.0	3.0	6.0
4.7	7.0	7.0	6.0	6.0	5.0	4.0	4.0	3.0	5.5
4.9	7.0	7.0	6.0	6.0	5.0	4.0	4.0	3.0	5.0
5.1	7.0	7.0	6.0	5.0	4.0	4.0	4.0	3.0	4.5
5.3	7.0	7.0	6.0	5.0	4.0	4.0	3.0	2.0	4.0
5.5	7.0	6.0	5.0	5.0	4.0	3.0	3.0	2.0	3.5
5.7	6.0	6.0	5.0	4.0	4.0	3.0	2.0	2.0	3.0
5.9	—	5.0	4.0	4.0	3.0	3.0	2.0	2.0	2.5
6.1	—	—	4.0	3.0	3.0	2.0	2.0	1.0	2.0
6.3	—	—	—	3.0	2.0	2.0	1.0	1.0	1.5

Table 8. Rate of 67% RNV agricultural limestone (T/A) needed to raise soil pH to 6.8.

Water pH of Sample	Buffer pH of Sample 5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	If Buffer pH is Unknown
4.5	7.0	7.0	7.0	6.0	5.0	5.0	4.0	3.0	6.0
4.7	7.0	7.0	7.0	6.0	5.0	5.0	4.0	3.0	6.0
4.9	7.0	7.0	7.0	6.0	5.0	5.0	4.0	3.0	6.0
5.1	7.0	7.0	7.0	6.0	5.0	5.0	4.0	3.0	6.0
5.3	7.0	7.0	7.0	6.0	5.0	4.0	3.0	3.0	5.5
5.5	7.0	7.0	6.0	5.0	5.0	4.0	3.0	3.0	5.0
5.7	7.0	7.0	6.0	5.0	5.0	4.0	3.0	2.0	4.5
5.9	—	6.0	5.0	5.0	4.0	4.0	3.0	2.0	3.5
6.1	—	—	5.0	4.0	4.0	3.0	2.0	2.0	3.0
6.3	—	—	—	3.0	3.0	3.0	2.0	1.0	2.5
6.5	—	—	—	—	2.0	2.0	2.0	1.0	2.0

Tobacco

Lime

Limestone should be applied in the fall and thoroughly mixed with the soil one to two years ahead of the crop. If applied in the spring before transplanting, or if more than 4 T/A are applied, plow one-half down and disc in the other half for soils with water pH below 6.0.

Rates—If water pH is below 6.4, see page 5 and use the appropriate amount for a target pH of 6.6.

Nitrogen

Rates—Nitrogen fertilization rates (see Table 9) depend primarily on the field cropping history and soil drainage class. See page 3 for soil drainage classes. Rotation to other crops is strongly recommended after two or more years of burley tobacco production in the same field. More frequent rotation may be necessary when growing dark tobacco or burley tobacco varieties with low levels of disease resistance.

Table 9. Nitrogen recommendations (Lb/A), burley and dark tobacco.

	Soil Drainage Class	
N Levels	Well-Drained	Moderately Well-Drained
	Lb N/A	
Low[1]	225 - 250	250 - 275
Medium[2]	200 - 225	225 - 250
High[3]	150 - 175	175 - 200

[1] Following tobacco or row crops.
[2] First-year tobacco following a grass or grass-legume sod.
[3] First-year tobacco following legume sod or legume cover crop.

Sources—All commonly available N sources can be used satisfactorily on tobacco, particularly on well-drained soils where a good liming program is followed and soil pH is maintained in the range of 6.0 to 6.6. If soil pH is moderately to strongly acid (pH 6.0 or less) and no lime is applied, using a nonacid-forming source of N (sodium nitrate, calcium nitrate, or sodium-potassium nitrate) will lower the risk of manganese toxicity. Use these sources (or ammonium nitrate or potassium nitrate) for sidedressing, because nitrate is more mobile in soil than ammonium nitrogen. If tobacco is grown on sandy soils or soils that tend to waterlog regardless of pH, using ammonium sources (urea, ammonium nitrate, ammoniated phosphates, ammonium sulfate, nitrogen solutions) will lower the risk of leaching and denitrification losses.

Time and Method—The entire nitrogen requirement can be applied pre-plant broadcast on well drained soils. However, Kentucky often has large rainfall amounts during April and May, so applying the broadcast nitrogen as near to transplanting as possible will significantly lessen the chances for losses of applied nitrogen. Apply the nitrogen after plowing and disc into the surface soil.

Because losses of fertilizer nitrogen can occur on sandy soils or soils with poor drainage, it is helpful to split nitrogen applications on these soils, applying one-third of the nitrogen before transplanting and the remaining nitrogen two or three weeks after transplanting. The use of poorly drained or somewhat poorly drained soils for tobacco production is not recommended.

Further efficiencies in nitrogen use, decreased manganese toxicity, and increased early growth can be obtained by banding most of the nitrogen (sidedress) after transplanting. These bands should be applied 10 to 12 inches to the side of the row in either one or two bands and at depths of 4 to 5 inches. The nitrogen should be banded all at 0 to 10 days after transplanting or in two applications, two-thirds at 0 to 10 days and one-third at four or five weeks after transplanting. If one third or more of the total nitrogen is applied after transplanting the rate from Table 9 should be reduced by 15 to 25 lbs. N per acre.

Animal Manures

Animal manures are known to contain chloride in concentrations high enough to reduce the quality of cured tobacco. Chloride in excess of 1% in cured tobacco leaf is considered unacceptable by the tobacco industry. Cattle and swine manure applications should be limited to no more than 10 tons per acre. Poultry manures should not be applied in the year tobacco is grown. Fall applications of poultry littler should not exceed 4 tons per acre on ground where tobacco will be planted the following spring. Fall manure applications should be made only when a living cover crop will be present to take up and recycle some of the available N.

Phosphate and Potash

Rates—Phosphorus and potassium fertilizer additions should be determined by soil testing. Based on soil test results, apply the recommended amounts indicated in Table 10. Research indicates that when soil test potassium is below 225 lb per acre, a broadcast application of potassium fertilizer is more effective than banding.

Sources—Research at the University of Kentucky has shown that applications after January 1 of chloride-containing nutrient sources such as muriate of potash at rates greater than 50 lb of chloride per acre lead to excessive levels of chloride in the cured burley tobacco leaf, increased curing and storage problems, decreased combustibility of the leaf, and, ultimately, greatly reduced quality and usability of the cured leaf. Consequently, sulfate of potash should be the major potassium fertilizer used after January 1. Because animal manures contain chloride, applications of dairy and swine manure should not exceed 10 tons per acre. Poultry manures should not be applied in the year tobacco is grown. Excessive rates of manure or manure used in conjunction with chlorine-containing fertilizers may result in unacceptable chlorine levels in the cured leaf.

Molybdenum

Molybdenum (Mo) is recommended for use on burley tobacco either as a broadcast soil application or as a mixture in transplant setter water when the soil pH is below 6.6. Recent research and field trials have shown that setter water applications are equally as effective as broadcast applications for supplying molybdenum to the crop. Molybdenum can be purchased in dry solid form or as a liquid. Either source is satisfactory when molybdenum is needed.

Soil Broadcast—Apply at the rate of 1 lb of sodium molybdate (6.4 oz of molybdenum) per acre. Dissolve this amount of dry sodium molybdate (or 2 gallons of 2.5% Mo liquid product) in 20 to 40 gallons of water and spray uniformly over each acre. Apply before transplanting and disc into the soil. Because sodium molybdate is compatible with many herbicides used on tobacco, it can be applied with herbicides normally applied as a spray in water. Combining the two chemicals can result in savings in application costs because only one trip over the field is necessary. It is recommended that not more than 2 lb of sodium molybdate (12.8 oz of molybdenum) per acre be used during a five-year period.

Setter Water—Use 0.25 to 0.50 lb sodium molybdate (1.6 to 3.2 oz of molybdenum) per acre. If dry sodium molybdate is used, divide the total recommended amount (0.25 to 0.50 lb/A) equally among the number of 52-gallon barrels of water used per acre. For example, if 8 barrels of water per acre are used, add one-eighth (0.2 to 0.4 oz sodium molybdate) of the total recommended amount to each barrel, and fill the barrel with water. Adding the dry material before filling the barrel will aid in dissolving and mixing. If a 2.5% liquid source of molybdenum is used with 8 barrels of setter water per acre, add 0.50 pint to 1 pint (1 to 2 cups) of the liquid product per barrel before filling the barrel with water.

Conventional Plant Beds

Site Selection—A gentle slope facing south or southeast is preferable. The soil should be high in fertility with a soil pH of 6.0 to 6.6. Rotate with sod crops after one or two years and use a green manure crop between consecutive years.

Fertilizer Rates—Salt damage is often the greatest problem in establishing tobacco seedlings in the plant bed and is commonly caused by excessive use of plant bed fertilizer. Recommendations for plant beds are shown in Table 11.

Incorporate into the surface 1 to 2 inches before seeding. If additional N is needed later by growing transplants, topdress with 0.5 to 1.0 lb actual N for each 100 sq yd. Nitrogen materials should be evenly broadcast when plants are dry, followed immediately with enough irrigation to remove fertilizer residues from the plant leaves.

Float Plant Beds

Source—Choose a water soluble fertilizer which has less P_2O_5 than N or K_2O (ie 20-10-20, 15-5-15, etc.) The source of nitrogen should be primarily from nitrate with little or no urea to avoid problems with plant toxicity (see AGR-163).

Table 10. Phosphate and potash recommendations (Lb/A), tobacco.

	Burley and Dark		Burley		Dark	
Category	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Lb/A K_2O Needed	Lb/A Test Result: K	Lb/A K_2O Needed
Very high	> 80	0	> 450	0	> 450	0
High	73 - 79	30	424 - 449	30	398 - 450	30
	71 - 72	40	417 - 423	40	383 - 397	40
	68 - 70	50	409 - 416	50	368 - 382	50
	66 - 67	60	402 - 408	60	353 - 367	60
	64 - 65	70	394 - 401	70	338 - 352	70
	62 - 63	80	387 - 393	80	323 - 337	80
	58 - 61	90	379 - 386	90	308 - 322	90
			372 - 378	100	296 - 307	100
			364 - 371	110		
			357 - 363	120		
			349 - 356	130		
			342 - 348	140		
			334 - 341	150		
			327 - 333	160		
			319 - 326	170		
			312 - 318	180		
			304 - 311	190		
Medium	54 - 57	100	296 - 303	200	286 - 295	110
	50 - 53	110	286 - 295	210	276 - 285	120
	46 - 49	120	276 - 285	220	266 - 275	130
	41 - 45	130	266 - 275	230	256 - 265	140
	37 - 40	140	256 - 265	240	246 - 255	150
	33 - 36	150	246 - 255	250	236 - 245	160
	29 - 32	160	236 - 245	260	226 - 235	170
			226 - 235	270	216 - 225	180
			216 - 225	280	206 - 215	190
			206 - 215	290		
Low	25 - 28	170	195 - 205	300	195 - 205	200
	22 - 24	180	184 - 194	310	184 - 194	210
	18 - 21	190	173 - 183	320	173 - 183	220
	14 - 17	200	162 - 172	330	162 - 172	230
	11 - 13	210	151 - 161	340	151 - 161	240
	7 - 10	220	140 - 150	350	140 - 150	250
			129 - 139	360	129 - 139	260
			118 - 128	370	118 - 128	270
			107 - 117	380	107 - 117	280
			96 - 106	390	96 - 106	290
Very low	< 7	230	< 96	400	< 96	300

Table 11. Plant bed fertilizer rates (Lb/Bed[1]), burley and dark tobacco.

pH Level	Lb/Bed Aglime Needed	N Level	Lb/Bed N Needed	P Level	Lb/Bed P_2O_5 Needed	K Level	Lb/Bed K_2O Needed
6.0 +	0		5	> 80	0	> 300	0
< 6.0	100 - 150			< 80	5 - 10	< 300	5

Note: Fertilization without soil test: 5 lb N, 5 - 10 lb P_2O_5, 5 lb K_2O per bed.

[1] A bed measures 900 square feet.

Rates and Timing—The initial application should be made to bring the N concentration in the water to approximately 100 parts per million (ppm). For a fertilizer that has 20% N (20-10-20), this would be 4.2 pounds of fertilizer for 1000 gallons of float water. For 15% N, this would be 5.6 pounds of fertilizer per 1000 gallons of float water. For good growth and reduced disease susceptibility N should be maintained in the range of 75 to 100 ppm. Inexpensive conductivity meters can be used to monitor fertility levels in the float bed (see AGR-174). The initial application can be made at seeding time however, waiting 4 to 7 days after seeding may reduce the chance of salt injury to young seedlings. When fertilizer is added after seeding, care should be exorcised to insure adequate mixing and even distribution of the fertilizer in the float water.

Corn

Lime

If water pH is below 6.2, see page 5 and use the appropriate amount for a target pH of 6.4.

Nitrogen

Also see the "Fertility Management" chapter in Cooperative Extension Service publication *A Comprehensive Guide to Corn Management* (ID-139).

Winter Legume Cover Crops—A winter legume cover crop can provide a substantial amount of nitrogen for corn with either no-tillage or conventional tillage. Research conducted by the University of Kentucky on no-tillage corn indicates that some legume cover crops can provide yield advantages beyond that provided by fertilizer nitrogen. Hairy vetch performed better than crimson clover or big flower vetch. The dense mulch resulting from a killed legume cover crop conserves soil water, aids in weed control, and helps to control soil erosion.

Three important factors should be considered when using a legume cover crop:

1. The amount of nitrogen provided will depend on the amount of growth the legume makes before it is chemically killed or plowed under. However, corn planting should not be delayed later than mid-May, particularly in well-drained soils.
2. A cover crop, legume or nonlegume, can deplete soil water during a dry spring, resulting in decreased germination and seedling growth of corn.
3. Some vetch seeds are hard and can remain in the soil for one or more years before germinating. The result can be volunteer vetch in small grains grown in rotation with corn unless the vetch is killed with herbicides in the early spring.

Placement—Small amounts of N plus K_2O can be applied in the row, but if more than 15 lb/A of N plus K_2O is banded, it should be banded at least 2 inches below the soil surface and 2 inches to the side of the row center. No more than 100 lb/A of N plus K_2O should be banded near the row. Fertilizer for banding near or in the row should not contain urea.

Adjustments to Nitrogen Recommendations

- **Irrigation**—Nitrogen rate on irrigated corn should be increased to 175-200 lb N/A due to increased risk of depletion of available N from crop uptake, leaching, and denitrification.
- **Sidedressed N**—On moderately well-drained to poorly drained soil, rates of nitrogen can be decreased by 35 lb/A if as much as two-thirds of the N is applied four to six weeks after planting.
- **Conservation Tillage**—On moderately well-drained to poorly drained soils, the risk of denitrification loss is great from N applied at or near planting on conservation-till corn. Alternative practices may include: 1) split N application as noted in comment above; 2) use of maximum rate in appropriate recommended range at planting; or 3) use of a nitrification inhibitor at planting with N sources that include urea, N-solutions, or anhydrous ammonia with minimum rate in the appropriate recommended range.
- **Surface-Applied Urea**—Volatilization losses of N from urea-based products can be significant with surface application after May 1. Alternative practices include: 1) irrigation or incorporation within two days after application; 2) use of a urease inhibitor; 3) use of maximum rate in appropriate recommended range.
- **Tiled Soils**—Poorly drained soils that have been tile drained should be considered as moderately well drained.

Table 12. Recommended application of nitrogen (Lb N/A), corn.

		Soil Drainage Class[2]		
	Tillage[1]	**Well-Drained**	**Moderately Well-Drained**	**Poorly Drained**
Corn, sorghum, soybean, small grain, fallow	Intensive	100-140	140-175	175-200
	Conservation	125-165	165-200	
Grass, grass-legume sod (4 yr or less), winter annual legume cover	Intensive	75-115	115-150	150-175
	Conservation	100-140	140-175	
Grass, grass-legume sod (5 yr or more)	Intensive	50-90	90-125	125-150
	Conservation	75-115	115-150	

[1] Intensive tillage has less than 30% residue cover, and conservation tillage has more than 30% residue cover on the soil at planting.

[2] Soil drainage class examples are given on page 3.

Table 13. Phosphate and potash recommendations (Lb/A), corn.

Category	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Grain: Lb/A K_2O Needed	Silage: Lb/A K_2O Needed
Very high			>420	0	0
High	>60	0	355 - 420	0	30
			336 - 354	0	40
			318 - 335	0	50
			301 - 317	0	60
Medium	46 - 60	30	282 - 300	30	70
	41 - 45	40	264 - 281	30	80
	37 - 40	50	242 - 263	30	90
	33 - 36	60	226 - 241	40	100
	28 - 32	70	209 - 225	50	110
			191 - 208	60	120
Low	23 - 27	80	173 - 190	70	130
	19 - 22	90	155 - 172	80	140
	14 - 18	100	136 - 154	90	150
	9 - 13	110	118 - 135	100	160
	6 - 8	120	100 - 117	110	170
Very low	1 - 5	200	<100	120	180

Zinc

Where zinc deficiency of corn is suspected or has previously occurred, a zinc soil test is helpful in determining if zinc should be applied. The following table lists soil test zinc levels at various soil pH ranges and soil test P levels below which a response to zinc fertilization is likely to occur. However, many other factors including weather conditions and cool soil temperatures affect availability of soil zinc to corn, making it difficult to predict a response to added zinc for a specific growing season. Zinc can be applied as a broadcast or band treatment. The broadcast treatment should raise the Zn soil test to acceptable levels for several years.

Table 14. Zinc recommendations[1] (Lb/A), corn.

Lb/A Test	Soil Water pH																	Lb/A Zn Needed	
Result: P	**6.0**	**6.1**	**6.2**	**6.3**	**6.4**	**6.5**	**6.6**	**6.7**	**6.8**	**6.9**	**7.0**	**7.1**	**7.2**	**7.3**	**7.4**	**7.5**	**7.6**	**Broadcast**	**Banded**
25	0.5	0.7	0.9	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.3	2.4	2.6	2.8	3.0	3.1	3.3	10-15	2-3
50	1.1	1.2	1.4	1.6	1.8	1.9	2.1	2.3	2.5	2.6	2.8	3.0	3.2	3.3	3.5	3.7	3.9		
75	1.4	1.5	1.7	1.9	2.1	2.2	2.4	2.6	2.8	3.0	3.1	3.3	3.5	3.6	3.8	4.0	4.2		
100	1.6	1.8	1.9	2.1	2.3	2.5	2.6	2.8	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.2	4.4		
150	1.9	2.1	2.3	2.4	2.6	2.8	3.0	3.1	3.3	3.5	3.7	3.8	4.0	4.2	4.4	4.5	4.7		
200	2.1	2.3	2.5	2.7	2.8	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.2	4.4	4.6	4.8	4.9	20-30	4-6
250	2.3	2.5	2.7	2.8	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.2	4.4	4.6	4.8	4.9	5.1		
300	2.4	2.6	2.8	3.0	3.2	3.3	3.5	3.7	3.9	4.0	4.2	4.4	4.6	4.7	4.9	5.1	5.3		
350	2.6	2.7	2.9	3.1	3.3	3.4	3.6	3.8	4.0	4.2	4.3	4.5	4.7	4.9	5.0	5.2	5.4		
400	2.7	2.9	3.0	3.2	3.4	3.6	3.7	3.9	4.1	4.3	4.4	4.6	4.8	5.0	5.1	5.3	5.5		
450	2.8	2.9	3.1	3.3	3.5	3.6	3.8	4.0	4.2	4.3	4.5	4.7	4.9	5.1	5.2	5.4	5.6		
500	2.8	3.0	3.2	3.4	3.6	3.7	3.9	4.1	4.3	4.4	4.6	4.8	5.0	5.1	5.3	5.5	5.7		

[1] Zinc and phosphorus levels shown are from soil extraction by the Mehlich III procedure. To determine if zinc is needed, find the appropriate soil test P level in the left column and read across the table to the appropriate soil pH level. If soil test zinc is less than that shown for the appropriate soil test P level and pH, apply fertilizer zinc as recommended in the table.

Lime

If water pH is below 6.2, see page 5 and use the appropriate amount for a target pH of 6.4.

Nitrogen

No nitrogen is recommended for well-nodulated soybean.

Double Cropping of Small Grains and Soybean—The phosphate recommendation should be taken from small grains, and the potash recommendation should be taken from soybean. This recommendation can be applied in the fall before seeding the small grain.

Inoculation

Soybean should be inoculated when planted in fields where soybean has not been grown in the past three to five years, or where previously grown soybean had few nodules. If inoculation is necessary, the inoculant should be applied to the seed or in the row at planting. Delays in planting inoculated seed often result in poor nodulation. Numbers of live rhizobia in inoculum decrease rapidly under dry conditions, exposure to sunlight and high temperatures, or when packaged dry with sodium molybdate and fungicides.

Molybdenum

If soils are limed to maintain pH values at 6.2 or above, aluminum and manganese toxicities and molybdenum deficiency usually do not occur in soybean. However, in soils with pH values below 6.2 at seeding time, molybdenum application to soybean is recommended. Apply 1 to 2 oz of sodium molybdate (0.4 to 0.8 oz of elemental molybdenum) per acre as a seed treatment. This is a satisfactory method of applying a small amount of molybdenum where no seed inoculant is needed. Where soybean seed is to be inoculated, including sodium molybdate with the inoculum may seriously lower the numbers of live rhizobia if not planted immediately. If both inoculum and molybdenum are needed, apply inoculum to the seed and broadcast the molybdenum on the soil. For each acre, dissolve 1 lb sodium molybdate (6.4 oz molybdenum) in 20 to 40 gallons of water and spray uniformly ahead of final seedbed preparation. Not more than 2 lb sodium molybdate (13 oz molybdenum) per acre should be used during any five-year period. Use of molybdenum should not be substituted for a good liming program.

Table 15. Phosphate and potash recommendations (Lb/A), soybean.

Category	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Lb/A K_2O Needed
High	>60	0	>300	0
Medium	40 - 60	30	242 - 300	30
	34 - 39	40	226 - 241	40
	28 - 33	50	209 - 225	50
			191 - 208	60
Low	22 - 27	60	173 - 190	70
	16 - 21	70	155 - 172	80
	11 - 15	80	136 - 154	90
	9 - 10	90	118 - 135	100
	7 - 8	100	100 - 117	110
	6	110		
Very low	1 - 5	120	82 - 99	120
			64 - 81	130
			46 - 63	140
			<46	150

Manganese

Foliar applications of manganese on manganese-deficient soybean have been superior to soil applications made at planting. Foliar manganese spray is recommended in two forms: chelated manganese at rates recommended by the manufacturer on the label, and manganese sulfate at the rate of 1.0 to 1.5 lb of actual manganese per acre in 20 to 25 gallons of water when the soybean is 10 inches high or higher. Symptoms of Mn deficiency are interveinal chlorosis of emerging leaves of soybean. Tissue analysis can also be used to evaluate the Mn status of the plant. The sufficiency range is 15-200 parts per million (ppm) Mn in the uppermost mature trifoliate leaf (petiole discarded). See *Soil Science News and Views* volume 10, number 8, "Manganese Fertility of Soybeans" for additional information.

Small Grains

(Barley, Oats, Rye, Wheat, and Triticale)

Lime

If water pH is below 6.2, see page 5, and use the appropriate amount for a target pH of 6.4.

Nitrogen

Fall Application—Only enough N to provide for good ground cover and to stimulate tillering is necessary. Seedings following tobacco, soybean, or well-fertilized corn will likely have enough carryover N for fall growth. For optimal fertilizer N efficiency, the total fall application should not exceed 40 lb N/A for seedings in fields with insufficient N carryover. Fall-applied N will be of little benefit where little fall growth is expected.

Spring Application—Application from late February to early April is the most effective. Where excessive rainfall occurs in late winter or early spring, split applications of spring-applied N may be justified.

Table 16. Spring nitrogen rates (Lb N/A), small grains.

Seedbed	Lb N/A
Tilled	60 - 90
No-till	90 - 120

Sources—Experimental results have shown little difference among nitrogen materials commonly used to supply supplemental N to small grains.

Small Grains for Grazing—Total forage production from small grains can be increased by splitting nitrogen applications between fall and spring. For fall grazing, apply 50 to 60 lb N/A at seeding. A late winter or early spring topdressing of 30 to 50 lb N/A will stimulate early growth for additional grazing.

Intensively Managed Wheat—When managed for high yields (70 to 100 bu/A), wheat should receive higher rates of N in the spring. If spring N is split into two applications (early to mid-February and mid- to late March), yields will be 3 to 5 bu/A higher than if all N is applied in a single application in mid- to late March. The February application should be made at "green-up," and the March application should be made at Feek's growth stage 5 or 6 (just prior to jointing or at jointing). "Green-up" may not occur until March in Central and Northern Kentucky.

Table 17. Spring nitrogen rates (Lb N/A), intensive wheat.

Applications	Feb	Mar	Total
	Lb N/A		
Single	0	95	95
Split	30 - 60	75 - 45	105

Double Cropping of Small Grains and Soybean—The phosphate recommendation should be taken from small grains, and the potash recommendation should be taken from soybean. This recommendation can be applied in the fall before seeding the small grain.

Small Grains for Silage—Small grains harvested for silage remove large amounts of potash from the soil. When double cropping small grains with corn or soybean where the small grain is to be cut for silage, apply recommended rates of potash for small grain at the time of seeding and for corn or soybean at the time of its seeding.

Table 18. Phosphate and potash recommendations (Lb/A), small grains.

Category	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Lb/A K_2O Needed
High	>60	0	>300	0
Medium	48 - 60	30	213 - 300	30
	45 - 47	40	187 - 212	40
	41 - 44	50		
	38 - 40	60		
	34 - 37	70		
	31 - 33	80		
Low	24 - 30	90	159 - 186	50
	17 - 23	100	132 - 158	60
	10 - 16	110	104 - 131	70
Very low	<10	120	<104	80

Grain Sorghum

Lime

If water pH is below 6.2, see page 5 and use the appropriate amount for a target of 6.4.

Placement—Banded fertilizer should be placed 2 inches below the soil surface and 2 inches to the side of the row with a maximum of 40 lb/A N plus K_2O. Additional fertilizer should be broadcast.

Table 19. Recommended application of nitrogen (Lb N/A), grain sorghum.

Previous Crop	Lb N/A Needed[1]
Corn, sorghum, soybean, small grain, fallow, set-aside	100 - 125[2]
Grass, grass-legume sod (4 years or less)	75 - 100
Grass, grass-legume sod (5 years or more)	50 - 75

[1] Recommended rates are for moderately well-drained soils which comprise the basis of current field data. See page 3 for soil drainage class.

[2] **Note:** Rates of nitrogen fertilization can be decreased 25 lb/A if two-thirds or more of the nitrogen is applied 4 to 6 weeks after planting.

Table 20. Phosphate and potash recommendations (Lb/A), grain sorghum

Category	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Lb/A K_2O Needed
High	>60	0	>300	0
Medium	46 - 60	30	242 - 300	30
	41 - 45	40	226 - 241	40
	37 - 40	50	209 - 225	50
	33 - 36	60	191 - 208	60
	28 - 32	70		
Low	23 - 27	80	173 - 190	70
	19 - 22	90	155 - 172	80
	14 - 18	100	136 - 154	90
	9 - 13	110	118 - 135	100
	6 - 8	120	100 - 117	110
Very low	<6	200	<100	120

HAY AND PASTURES

New Seedings

Lime

See page 5 and use the appropriate amount for a target pH of 6.4. For long-term production of alfalfa and alfalfa grass, it is important to raise pH and keep it maintained in the range of 6.5 to 7.0. (See page 5 for the amount of lime for a target pH of 6.8.)

Nitrogen

Apply 0 to 30 lb N/A at seeding for legumes or grass-legume mixtures and 0 to 50 lb N/A for straight grass. If the field has a history of high N applications, omit N at seeding.

Surface Mine Reclamation

See page 3 for more details.

Molybdenum

If soils are limed to maintain pH values at 6.2 or above, aluminum and manganese toxicities and molybdenum deficiency usually do not occur in forage legumes. However, in soils having pH values below 6.2 at seeding time, molybdenum application to these legumes is recommended. Apply at the rate of 1 lb of sodium molybdate (6.4 oz of molybdenum) per acre. Dissolve this amount of molybdate in 20 to 40 gallons of water, and spray uniformly over each acre. Apply before planting and disc into the soil. It is recommended that not more than 2 lb of sodium molybdate (12.8 oz of molybdenum) per acre be used during a five-year period.

Inoculation

Appropriate good-quality inoculant should be applied to legume seed or in the row at planting. Delays in planting inoculated seed may result in poor root nodulation. Live rhizobia decrease rapidly in inoculum under dry conditions, exposure to sunlight and high temperatures, or when packaged dry with sodium molybdate and fungicides.

Table 21. Phosphate and potash recommendations (Lb/A), hay and pasture, new seedings.

	Alfalfa, Alfalfa-grass, Clover, Clover-grass		Alfalfa, Alfalfa-grass		Clover, Clover-grass		Cool-season Grasses			
Category	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Lb/A K_2O Needed	Lb/A Test Result: K	Lb/A K_2O Needed	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Lb/A K_2O Needed
High	>60	0	>450	0	>300	0	>60	0	>300	0
			394 - 450	60						
			363 – 393	90						
			338 – 362	100						
			313 – 337	110						
			297 – 312	120						
Medium	51 - 60	30	291 – 296	130	266 - 300	30	48 - 60	30	213 - 300	30
	48 - 50	40	285 – 290	140	256 - 265	40	45 - 47	40	187 - 212	40
	46 - 47	50	279 – 284	150	246 - 255	50	41 - 44	50		
	43 - 45	60	272 – 278	160	236 - 245	60	38 - 40	60		
	40 - 42	70	266 – 271	170	226 - 235	70	34 - 37	70		
	37 - 39	80	260 – 265	180	216 - 225	80	31 - 33	80		
	35 - 36	90	254 – 259	190	206 - 215	90				
	32 - 34	100	247 – 253	200	191 - 205	100				
	28 - 31	110	241 – 246	210						
			235 – 240	220						
			229 – 234	230						
			222 – 228	240						
			216 – 221	250						
			210 – 215	260						
			204 – 209	270						
Low	23 - 27	120	194 – 203	280	173 - 190	110	24 - 30	90	159 - 186	50
	19 - 22	130	180 – 193	290	155 - 172	120	17 - 23	100	132 - 158	60
	14 - 18	140	166 – 179	300	136 - 154	130	10 - 16	110	104 - 131	70
	9 - 13	150	152 – 165	310	118 - 135	140				
			139 – 151	320	100 - 117	150				
			125 – 138	330						
			111 – 124	340						
			97 – 110	350						
Very low	<9	160	< 97	360	<100	160	<10	120	<104	80

Hay and Pastures

Established Stands

Topdressing Legumes and Grass-Legume Mixtures

Top production from hay and pasture fields can best be obtained if soil test levels are in the range of 50 to 60 P and 270 to 300 K and are maintained at those levels. If initial soil test levels are below these ranges, they can be raised more quickly by heavy nutrient applications at seeding and then maintained by annual topdressings as outlined in the following tables. Another alternative is to raise soil test levels gradually over a longer period of years by foregoing a heavy nutrient application at seeding and then increasing topdressing rates each year over the rates shown. An initial soil test followed by periodic soil tests will indicate changes taking place in the fields' fertility levels.

Lime

See page 5 and use the table to determine the appropriate amounts for a target pH of 6.4. For alfalfa or alfalfa-grass, use the table on page 5 for a target pH level of 6.8 when water pH is below 6.6.

Surface Mine Reclamation

See page 3 for more details.

Higher Yields

For alfalfa yields above 5 tons per acre and red clover yields above 3 tons per acre, fields should be sampled every year to monitor P and K levels.

Luxury Consumption of Potassium

Luxury consumption is a phenomenon that all alfalfa producers should be aware of and should try to avoid. Luxury consumption occurs when the alfalfa plant takes up more K than is needed for maximum yield. The additional K is removed with hay harvest and is not available for future cuttings. To minimize luxury consumption, K fertilizer should not be applied in the spring prior to the first cutting for existing stands. For new stands of alfalfa, K fertilizer should be thoroughly incorporated prior to planting.

Nitrogen

Topdress applications of N are not generally recommended for legumes or legume-grass mixtures containing more than 25% legumes. If there is less than 25% legume in a legume-grass stand, topdress with N at rates shown for established grass stands.

Boron

For alfalfa production, apply 1.5 to 2.0 lb per acre of elemental boron (B) every two years either in a borated fertilizer or as fertilizer borate. If boron-containing materials or wastes from a coal-fired power plant have been applied in successive years to established stands of alfalfa, the field should be tested for boron. If soil test B exceeds 2.0 lb per acre, additional B should not be applied.

Table 22. Phosphate and potash recommendations (Lb/A), hay and pasture, annual topdressing.

	Alfalfa or Alfalfa-Grass				Clover or Clover-Grass			
Category	**Lb/A Test Result: P**	**Lb/A P_2O_5 Needed**	**Lb/A Test Result: K**	**Lb/A K_2O Needed**	**Lb/A Test Result: P**	**Lb/A P_2O_5 Needed**	**Lb/A Test Result: K**	**Lb/A K_2O Needed**
High	>60	0	>450	0	>60	0	>300	0
			394 - 450	60				
			363 – 393	90				
			338 – 362	100				
			313 – 337	110				
			297 – 312	120				
Medium	46 - 60	30	291 – 296	130	41 - 60	30	271 - 300	30
	41 - 45	40	285 – 290	140	36 - 40	40	263 - 270	40
	37 - 40	50	279 – 284	150	31 - 35	50	255 - 262	50
	33 - 36	60	272 – 278	160			246 - 254	60
	28 - 32	70	266 – 271	170			238 - 245	70
			260 – 265	180			230 - 237	80
			254 – 259	190			221 - 229	90
			247 – 253	200			213 - 220	100
			241 – 246	210			205 - 212	110
			235 – 240	220				
			229 – 234	230				
			222 – 228	240				
			216 – 221	250				
			210 – 215	260				
			204 – 209	270				
Low	23 - 27	80	194 – 203	280	27 - 30	60	191 - 204	120
	19 - 22	90	180 – 193	290	23 - 26	70	173 - 190	130
	14 - 18	100	166 – 179	300	19 - 22	80	155 - 172	140
	9 - 13	110	152 – 165	310	16 - 18	90	136 - 154	150
			139 – 151	320	12 - 15	100	118 - 135	160
			125 – 138	330	8 - 11	110	100 - 117	170
			111 – 124	340				
			97 – 110	350				
Very low	<9	120	<97	360	<8	120	<100	180

Renovation of Grass with Clovers or Annual Lespedeza

Lime

If water pH is below 6.2, see the table on page 5 for the appropriate amount to apply for a target pH of 6.4.

Nitrogen

One critical factor in establishing legumes in established grass sods is grass competition with young legume seedlings. Use of N at renovation will stimulate grass growth and increase the likelihood of failure in getting a stand of the legume. However, if there is a need for increased grass production during the fall preceding spring legume renovation, a small amount of N (up to 50 lb/A) can be topdressed from August 1 to August 15. Be sure any increased grass growth is grazed off before tilling the sod for legume renovation.

Annual Topdressing

See recommendations for topdressing legume-grass mixtures.

Inoculation

Appropriate inoculant should be applied to the legume seed or in the row at planting. Delays in planting inoculated seed often result in poor inoculation. Live rhizobia in inoculum decrease rapidly under dry conditions, exposure to sunlight and high temperatures, or when packaged dry with sodium molybdate and fungicides.

Table 23. Phosphate and potash recommendations (Lb/A), clover or annual Lespedeza (renovation into established grass).

Category	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Lb/A K_2O Needed
High	>60	0	>300	0
Medium	48 - 60	30	257 - 300	30
	45 - 47	40	244 - 256	40
	41 - 44	50	232 - 243	50
	38 - 40	60	219 - 231	60
	34 - 37	70	207 - 218	70
	31 - 33	80	187 - 206	80
Low	24 - 30	90	159 - 186	90
	17 - 23	100	132 - 158	100
	10 - 16	110	104 - 131	110
Very low	<10	120	<104	120

Molybdenum

Molybdenum deficiency usually does not occur in forage legumes when soil pH is 6.2 or higher. However, with pH values below 6.2 at seeding, molybdenum application to legumes is recommended. Apply at the rate of 1 lb of sodium molybdate (6.4 oz actual Mo) per acre. Dissolve this amount of sodium molybdate in 20 to 40 gallons of water and spray uniformly over each acre. Apply before planting and disc into the soil. Not more than 2 lb of sodium molybdate (12.8 oz of Mo) per acre should be used during a five-year period.

Topdressing

Cool-season grasses such as tall fescue, bluegrass, timothy, orchardgrass, and bromegrass grow best from early spring into early summer and again in the fall. If moisture and soil test levels of P and K are adequate (P > 30, K > 200), the use of nitrogen greatly stimulates their growth during these peak production periods. The use of nitrogen should depend on what is expected from the grass. Nitrogen fertilization can help increase total production and protein content and shift seasonality of production. However, unless the increased yields are utilized, there will be no return to the expense of adding N.

Nitrogen Management

Increase Total Production—Research data for a period of years indicate that dry matter can be increased from about a ton per year with no nitrogen up to about 4 tons per year with up to 200 lb N per acre.

Shift Seasonality of Production—Timely nitrogen applications will increase the production of grasses during particular seasons. A topdressing in late winter or early spring just before growth begins will increase growth so that grazing can begin about two weeks ahead of pastures receiving no nitrogen. This effect can be used to lower overwintering feed costs from barnlot feeding. Another topdressing in late spring following a grazedown or hay clipping will increase growth that will carry over into the normally low summer production period. Another topdressing following a grazedown or clipping in late summer will stimulate fall growth, which, if properly utilized, will extend grazing several weeks later into the fall and winter. This is a practical method to lower winter costs from barnlot feeding by keeping animals on pasture longer.

Sources—Research in Kentucky has shown that during late winter and early spring there is little difference among commonly used N sources for topdressing cool-season grasses. After early May, there is a high risk that topdressed urea will not be as effective as other sources. Average values for efficiency of urea-applied topdress after early May ranged from 78% to 51% percent of that of ammonium nitrate, depending largely on the length of time after application before rainfall. When a urease inhibitor is used in conjunction with urea, the efficiency of urea is very comparable to ammonium nitrate. For urea (without an inhibitor) to be an economical substitute for ammonium nitrate if applied after early May, the cost per unit of nitrogen from urea probably should be 15% to 20% less than ammonium nitrate. Research indicates that efficiency of liquid nitrogen applied after early May is between that of urea and ammonium nitrate. A urease inhibitor can also be used in conjunction with liquid nitrogen.

Tetany problems with cattle are sometimes encountered on straight grass pastures, particularly with nursing cows where grass pasture is the only source of feed. Tetany in such animals results from an imbalance of magnesium in their blood. Supplemental feeding of magnesium to nursing cows on such fields is recommended as a means of lowering tetany risks. Applying fertilizer containing magnesium is not recommended to offset potential grass tetany problems. There is little guarantee that the plant will take up the additional applied magnesium when soil test levels are adequate. See Extension publication *Grass Tetany in Beef Cattle* (ASC-16) for detailed recommendations.

Grass Seed Production—For pure stands of tall fescue and bluegrass from which seed will be harvested, an additional topdressing of 60 to 70 lb N/A around December 1, after grazedown, will increase seed yields the following year.

Table 24. When to topdress nitrogen.

Date	Lb N/A per Application[1]
Feb. 15 - March 15	up to 100
May 1 - 15	up to 50
Aug. 1 - 15	up to 80

[1] Total amount of N to topdress should depend on how much additional production is needed. If a total of more than 100 lb of N per acre per year is to be used, it should be applied in split applications. Suggested dates and rates for topdressing with N are shown above.

Lime

See page 5 and use the appropriate amount for a target pH of 6.4.

Surface Mine Reclamation

See page 3 for more details.

Table 25. Phosphate and potash recommendations (Lb/A), cool-season grasses, annual topdressing.

Category	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Pasture:* Lb/A K_2O Needed	Hay: Lb/A K_2O Needed
Very high			>420	0	0
High	>60	0	321 - 420	0	30
			301 - 320	0	40
Medium	46 - 60	30	267 - 300	30	50
	41 - 45	40	240 - 266	30	60
	37 - 40	50	213 - 239	30	70
	33 - 36	60	187 - 212	40	80
	28 - 32	70			
Low	23 - 27	80	159 - 186	50	90
	19 - 22	90	132 - 158	60	100
	14 - 18	100	104 - 131	70	110
	9 - 13	110			
Very low	<9	120	<104	80	120

* If pasture is clipped and harvested for hay in the spring, K applications should be according to the hay recommendations.

Hay and Pastures

Warm-Season Forages

Sudangrass, Millets, Sorghum-Sudangrass Hybrids

Consult Extension publication *Producing Summer Annual Grasses for Emergency or Supplemental Forage* (AGR-88) for management details. The pH should be in the range of 5.8 to 6.4. If establishing stand, lime to pH 6.4.

Nitrogen—Apply 60 to 100 lb N/A at seeding plus 40 to 60 lb N/A topdressed after first and second grazings or harvests.

Perennial Warm-Season Crops

Conservation Buffer and Filter Strip—When these crops are used as the primary vegetation in a conservation buffer, filter strip, or conservation reserve program, fertilizer or other nutrient sources should not be applied. In these situations, the vegetation is used primarily to remove and immobilize nutrients. This use may involve mowing with no plant removal so that nutrients in plant residues are recycled back to the soil.

Bermudagrasses

The pH should be maintained in the range of 5.8 to 6.4. If establishing stand and water pH is less than 6.2, lime to pH 6.4 (see page 5).

When to Apply N—The total amount of N used should be based on the amount of forage needed and whether it is grazed or cut for hay. Nitrogen should be applied in split applications for best results. For top production of hay, apply 100 lb N just before growth starts in the spring and 100 lb N after each clipping except the last one.

For establishing new stands, use only 50 to 60 lb N/A at planting. As ground cover is attained, an additional 30 to 50 lb applied around August 15 can be beneficial in stimulating first-year growth.

Native Warm-Season Grasses

Bluestems, Switchgrass, Indiangrass, Side Oats Grama, Eastern Gamagrass

See the publication *Warm Season Perennial Grasses for Forage in Kentucky* (AGR-145) for more detailed information.

Table 26. Phosphate and potash recommendations (Lb/A), annual warm-season crops.

Category	Lb/A Test Result: P	Lb/A P_2O_5 Needed	Lb/A Test Result: K	Lb/A K_2O Needed
High	>60	0	>300	0
Medium	48 - 60	30	271 - 300	30
	45 - 47	40	263 - 270	40
	41 - 44	50	255 - 262	50
	38 - 40	60	246 - 254	60
	34 - 37	70	238 - 245	70
	31 - 33	80	230 - 237	80
			221 - 229	90
			213 - 220	100
			205 - 212	110
Low	24 - 30	90	191 - 204	120
	17 - 23	100	173 - 190	130
	10 - 16	110	155 - 172	140
			136 - 154	150
			118 - 135	160
			100 - 117	170
Very low	<10	120	<100	180

Lime—Soil pH should be in the range of 5.8 to 6.4. When establishing a stand if water pH is below 6.2, apply sufficient lime to raise the pH to 6.4.

Nitrogen—Do not apply nitrogen at the time of seeding. A topdressing of 40 to 60 lb N/A can be applied in July of the seeding year to aid establishment. For established stands after the seeding year, apply 40 to 60 lb N/A in April and again following a harvest in June or July for increased yields.

Conservation and/or Wildlife Use—Native grasses not used as forage (top growth not removed from the field or area) seldom need to be fertilized after establishment. Apply lime when soil test pH levels are below 5.8.

Surface Mine Reclamation

See page 3 for more details.

Table 27. Annual nitrogen, phosphate, potash applications (Lb/A), bermudagrasses.

	Annual Application					
	Pasture			Hay		
Lb/A Soil Test Level	Lb/A N	Lb/A P_2O_5	Lb/A K_2O	Lb/A N	Lb/A P_2O_5	Lb/A K_2O
High *(>60 P, 300 K)*	120 - 240	0	0	120 - 400	0	0
Medium *(60-30P, 300-200K)*	120 - 240	30 - 65	30 - 90	120 - 400	30 - 95	30 - 180
Low *(<30P, 200K)*[1]	120 - 240	65 - 120	90 - 180	120 - 400	95 - 120	180 - 360

[1] The maximum P_2O_5 or K_2O rate shown should be used if P is less than 10 or K is less than 100.

Table 28. Annual phosphate and potash applications (Lb/A), establishment or forage use of native warm-season grasses.

Lb/A Soil Test Level	Lb/A P_2O_5	Lb/A K_2O
High *(>60 P, 300 K)*	0	0
Medium *(60-30 P, 300-200 K)*	30 - 40	30 - 50
Low* *(<30 P, 200 K)*	40 - 80	50 - 100

* The maximum rates should be used if P is less than 6 lb/A or K is less than 90 lb/A.

Lawns and General Turf

Establishing New Turf

Mix lime, nitrogen, P_2O_5, and K_2O into the top 4 to 6 inches of soil before seeding. Use 1.5 lb N/1000 sq ft and lime, P_2O_5, and K_2O rates suggested in the following tables.

Lime—Use the amount of limestone to achieve a target pH of 6.4 indicated in Table 29.

Table 29. Rate (Lb/1000 sq ft)[1] of agricultural limestone needed to raise soil pH to 6.4, lawns and turf.

Water pH	Buffer pH of Sample								If Buffer pH
of Sample	5.5	5.7	5.9	6.1	6.3	6.5	6.7	6.9	Is Unknown
4.5	320	300	280	250	220	180	150	130	180
4.7	320	300	280	240	200	170	140	120	170
4.9	310	290	260	230	190	150	130	110	160
5.1	310	290	260	220	180	130	100	80	150
5.3	300	280	240	210	160	120	90	70	130
5.5	290	270	230	190	140	100	70	60	120
5.7	280	260	220	170	120	90	60	50	100
5.9	—	240	200	150	100	80	50	40	80
6.1	—	—	180	120	80	60	40	40	60
6.3	—	—	—	90	60	40	40	30	40

[1] See page 5 for limestone rates needed, expressed in T/A.

Maintenance of Turf

Lime—Based on soil test levels, apply limestone at rates indicated under "Establishing New Turf" section. Apply no more than 70 to 100 lb/1000 sq ft at once. Additional lime can be supplied as repeated applications at three- to six-month intervals.

Nitrogen—Apply 1 to 1.5 lb actual N/1000 sq ft per application or 40 to 60 lb/A. The frequency of nitrogen applications depends on the level of overall maintenance. The following low- and medium-maintenance levels are best for general lawns that get little or no summer irrigation. The high and very high levels usually require some irrigation and a high mowing frequency (see Table 31).

Phosphate and Potash—Based on soil test levels, apply phosphate or potash at rates indicated under "Establishing New Turf" section.

See Extension publication *Lawn Fertilization in Kentucky* (AGR-53) for more specific details on lawn fertilization.

Table 30. Phosphate and potash recommendations for lawns and turf.

Lb/A	Lb/1000 Sq Ft	
Soil Test Level	P_2O_5	K_2O
High *(>60P, 300K)*	0 - 1	0 - 1
Medium *(60-30P, 300-200K)*	1 - 2	1 - 2
Low *(<30P, 200K)*	3 - 5	3 - 5

Table 31. Best months to make nitrogen applications for turf maintenance.

N Applications per Year		Cool-Season Grasses[1]	Warm-Season Grasses[2]
Low	1	Oct. - Nov.	June
Medium	2	Sept. - Oct. Nov. - Dec.	May, July
High	3	Sept. - Oct. Oct. - Nov. Nov. - Dec.	April, June, August
Very high	4	Sept. - Oct. Oct. - Nov. Nov. - Dec. late May - early June (1/2 rate)	April, May, June, August

[1] Kentucky bluegrass and tall fescue. Red fescue and all cool-season grasses grown in shady lawns should be fertilized only one time per year.
[2] Bermudagrass and zoysiagrass. Zoysiagrass needs only a minimal amount of N after lawn is fully established.

Tree Fruits, Blackberries, Raspberries, Blueberries, and Grapes

New Plantings

Lime—Limestone should be applied three to six months before planting and worked into the soil. Tree fruits, blackberries, and raspberries are most productive when soil pH is from 6.4 to 6.6. For grape plantings, adjust the soil pH to 6.5 at establishment and maintain pH in the range of 5.5 to 6.0 during production for American and French-American hybrid grapes. European or Vitis vinifera grapes perform best at a pH range of 6.0 to 7.0. See page 5 and use the appropriate table for the target pH; apply the amount of recommended lime.

For blueberries, adjust the soil pH to between 4.5 to 5.2. Read Extension publication Growing Highbush Blueberries in Kentucky (HO-60) for further information on adjusting soil pH to this range.

Nitrogen—Nitrogen fertilization rates depend on the field cropping history and soil types. Apply no more than 100 lb of nitrogen per acre (3.7 oz nitrogen per 100 sq ft). Nitrogen is most effective when it is applied at planting time.

The above recommendations are for establishment only. During subsequent seasons, fertilizer application should be based on the plant growth rate and condition. Tissue analysis is the most accurate method for determining plant nutrient status for commercial plantings. Contact your county Cooperative Extension Service agent to obtain information and a source of plant analysis kits.

Magnesium—Fruit crops require more magnesium than most agronomic crops. The soil should be adjusted if soil test Mg is less than 120 lb of magnesium per acre prior to planting. Use Table 33 for adjusting Mg levels in the soil based on soil test Mg.

Table 32. Phosphate and potash for tree fruits, blackberries, raspberries, blueberries, and grapes.

Lb/A Soil Test Level	P_2O_5 Lb/A	P_2O_5 Oz/100 Sq Ft	K_2O Lb/A	K_2O Oz/100 Sq Ft
High *(>70 P, >300 K)*	0	0	0	0
Medium *(70-35 P, 300-200 K)*	0 - 80	0 - 3	0 - 80	0 - 3
Low *(<35 P, <200 K)*	80 - 120	3 - 5	80 - 120	3 - 5

Table 33. Magnesium recommendations (Lb/A), tree fruits, blackberries, raspberries, blueberries, and grapes.

Lb/A Soil Test Level	Lb/A Mg
Low *(below 60)*	80
Medium *(61-120)*	20 - 80
High *(above 120)*	0

STRAWBERRIES

Establishment

Lime—Limestone should be applied three to six months before planting and worked into the top 4 inches of soil. Strawberries are most productive when the soil pH ranges from 6.0 to 6.5. See page 5 and apply recommended lime for a target pH of 6.4. If established plantings need lime, aglime application during the dormant season is best.

Nitrogen—Nitrogen fertilizer should not exceed 60 lb N/A (2.2 oz nitrogen per 100 sq ft) broadcast before planting. Sidedressing with 30 lb N/A in two bands, one on each side of the row with each band placed 2 to 4 inches deep and 8 inches from the plants, is just as effective as broadcast and reduces competition from weeds.

For early fall application, apply 30 to 40 lb N/A between August 15 and September 10 to promote fruit bud development for the next season.

Spring nitrogen applications are generally avoided during fruiting years, because these applications lead to high vegetative growth, lower fruit yields, delayed ripening, and increased fruit rot problems.

Magnesium—See Table 33 for recommendations.

Renovation

Use plant analysis during midseason harvest and fertilize accordingly, or obtain a soil test following harvest. Apply 30 lb N/A (1.1 oz N/100 sq ft), and follow lime recommendations for a target pH of 6.4 and phosphate and potash recommendations in the "Establishment" section. Fertilization should be done before any cultivation during renovation. Contact your county Extension office to obtain plant analysis kits.

Types of Application

Broadcast—Apply fertilizer over the tops of the plants when leaves are dry. Avoid possible foliage burn by brushing nitrogen granules off the plant leaves. A canvas attached to the back of the fertilizer applicator works well in brushing fertilizer from the plants.

Sidedress—Banded fertilizer should be placed 2 inches below the soil surface and 6 to 8 inches from the plants on established stands.

Table 34. Phosphate and potash recommendations for strawberries.

	P_2O_5		K_2O	
Lb/A Soil Test Level	**Lb/A**	**Oz/100 Sq Ft**	**Lb/A**	**Oz/100 Sq Ft**
High *(>70 P, > 300 K)*	0	0	0	0
Medium *(70-35 P, 300-200 K)*	0 - 80	0 - 3	0 - 40	0 - 1.5
Low *(<35 P, <200 K)*	80 - 150	3 - 6	40 - 80	1.5 - 3

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN (CNMP)

FOR

Kenneth Rust

September 2008

APPENDIX D

- NRCS Conservation Practice Standard Nutrient Management, code 590.
- Nutrient Management in Kentucky, University of Kentucky cooperative Extension Service publication, IP-71.
- Taking Soil Test Samples, University of Kentucky cooperative Extension Service publication, AGR-16.
- Sampling Animal Manure, University of Kentucky cooperative Extension Service publication, ID-148.
- Lime and Nutrient Recommendations, University of Kentucky cooperative Extension Service publication, AGR-1

COMPREHENSIVE NUTRIENT MANAGEMENT PLAN (CNMP)

FOR

Kenneth Rust

September 2008

APPENDIX E

- Soil Test Reports for all fields manure Planned to be applied
- Manure Test Report

Operators Record of Land Application in 2010

- Soil Test Reports for all fields manure Planned to be applied
- Manure Test Report

Operators Record of Land Application in 2011

- Soil Test Reports for all fields manure Planned to be applied
- Manure Test Report

Operators Record of Land Application in 2012

- Soil Test Reports for all fields manure Planned to be applied
- Manure Test Report

Operators Record of Land Application in 2013

Operators Record of manure sold or given away

Appendix E—page --Operators Record of Waste application in 2010

Farm ID. (Tract)	Field Numbers That make up unit	Total Acres manure was applied	Crop Or Pasture Type In 2009	Application Date	Form of Waste	Application method	Tons Of Poultry Litter Applied Per Acre	Resulting lbs per acre of Nitrogen applied	Soil Test Phosphorus (STP) for this land unit (lbs/ac)	NRCS Phosphorus Index Rating For this Crop unit

Appendix E—page --Operators Record of Waste application in 20ll

Farm ID. (Tract)	Field Numbers That make up unit	Total Acres manure was applied	Crop Or Pasture Type In 2009	Application Date	Form of Waste	Application method	Tons Of Poultry Litter Applied Per Acre	Resulting lbs per acre of Nitrogen applied	Soil Test Phosphorus (STP) for this land unit (lbs/ac)	NRCS Phosphorus Index Rating For this Crop unit

Appendix E—page --Operators Record of Waste application in 2012

Farm ID. (Tract)	Field Numbers That make up unit	Total Acres manure was applied	Crop Or Pasture Type In 2009	Application Date	Form of Waste	Application method	Tons Of Poultry Litter Applied Per Acre	Resulting lbs per acre of Nitrogen applied	Soil Test Phosphorus (STP) for this land unit (lbs/ac)	NRCS Phosphorus Index Rating For this Crop unit

Appendix E—page --Operators Record of Waste application in 2013

Farm ID. (Tract)	Field Numbers That make up unit	Total Acres manure was applied	Crop Or Pasture Type In 2009	Application Date	Form of Waste	Application method	Tons Of Poultry Litter Applied Per Acre	Resulting lbs per acre of Nitrogen applied	Soil Test Phosphorus (STP) for this land unit (lbs/ac)	NRCS Phosphorus Index Rating For this Crop unit

Appendix E—page --Operators Record of Waste application in 20

Farm ID. (Tract)	Field Numbers That make up unit	Total Acres manure was applied	Crop Or Pasture Type In 2009	Application Date	Form of Waste	Application method	Tons Of Poultry Litter Applied Per Acre	Resulting lbs per acre of Nitrogen applied	Soil Test Phosphorus (STP) for this land unit (lbs/ac)	NRCS Phosphorus Index Rating For this Crop unit

Appendix E—page --Operators Record of Waste application in 20

Farm ID. (Tract)	Field Numbers That make up unit	Total Acres manure was applied	Crop Or Pasture Type In 2009	Application Date	Form of Waste	Application method	Tons Of Poultry Litter Applied Per Acre	Resulting lbs per acre of Nitrogen applied	Soil Test Phosphorus (STP) for this land unit (lbs/ac)	NRCS Phosphorus Index Rating For this Crop unit

Appendix E—page --Operators Record of Waste application in 20

Farm ID. (Tract)	Field Numbers That make up unit	Total Acres manure was applied	Crop Or Pasture Type In 2009	Application Date	Form of Waste	Application method	Tons Of Poultry Litter Applied Per Acre	Resulting lbs per acre of Nitrogen applied	Soil Test Phosphorus (STP) for this land unit (lbs/ac)	NRCS Phosphorus Index Rating For this Crop unit

Appendix E --Operators Record of manure sold or given away

Name of Customer / Recipient	Address	Amount in Total Gallons	Date Sold or give away

Additional Comments:

Appendix E --Operators Record of manure sold or given away

Name of Customer / Recipient	Address	Amount in Total Gallons	Date Sold or give away

Additional
Comments:____

Appendix E --Operators Record of manure sold or given away

Name of Customer / Recipient	Address	Amount in Total Gallons	Date Sold or give away

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Appendix E --Operators Record of manure sold or given away

Name of Customer / Recipient	Address	Amount in Total Gallons	Date Sold or give away

Additional
Comments:____